HEATING & VENTILATING
AIR CONDITIONING

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FOR AUGUST, 1937

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For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning.

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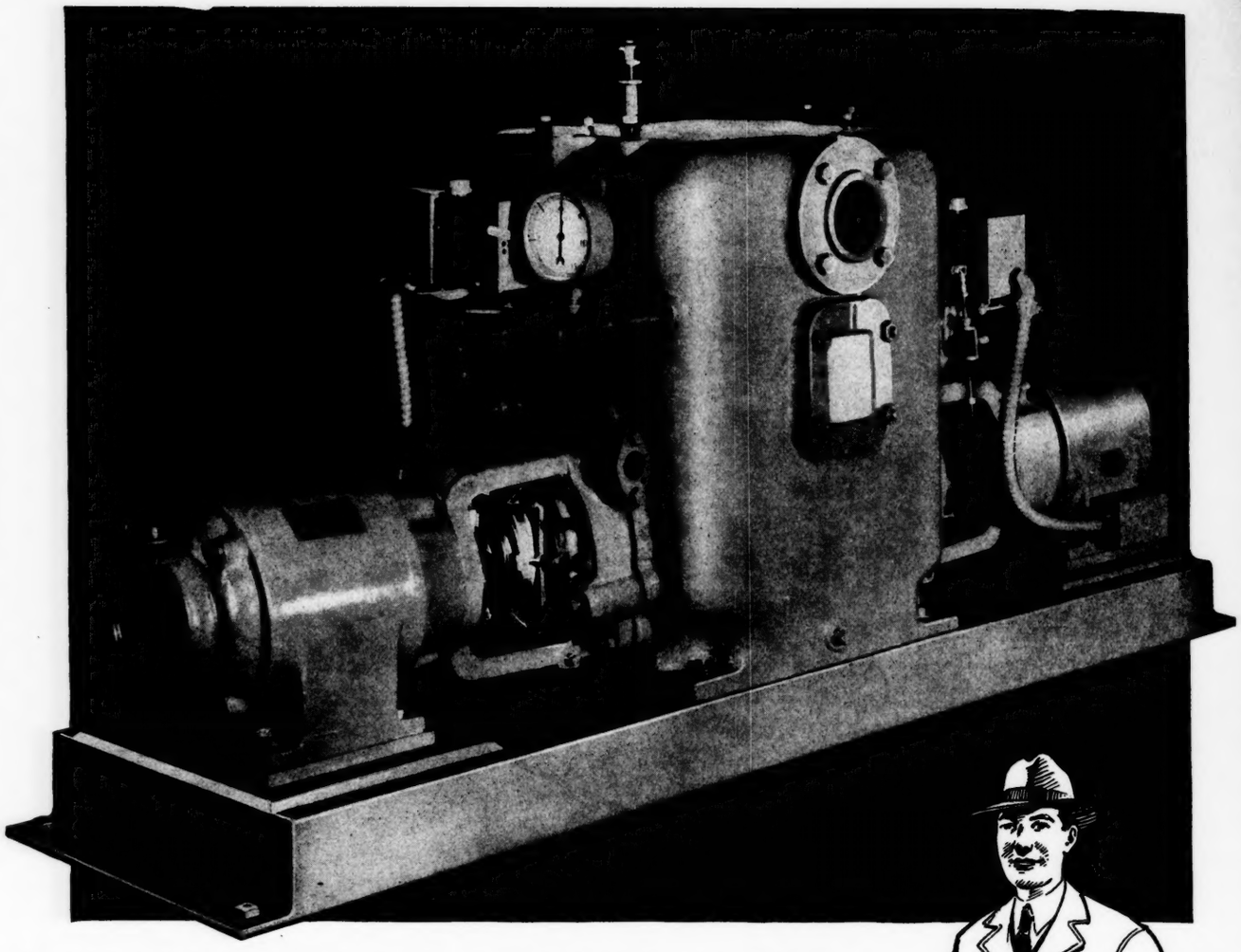

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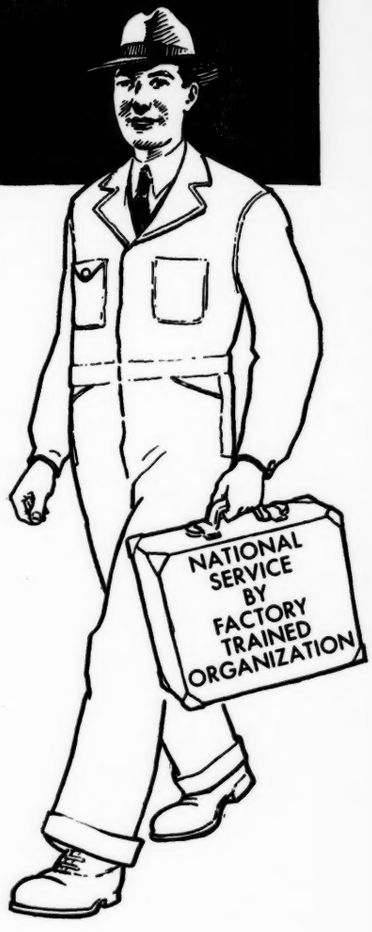

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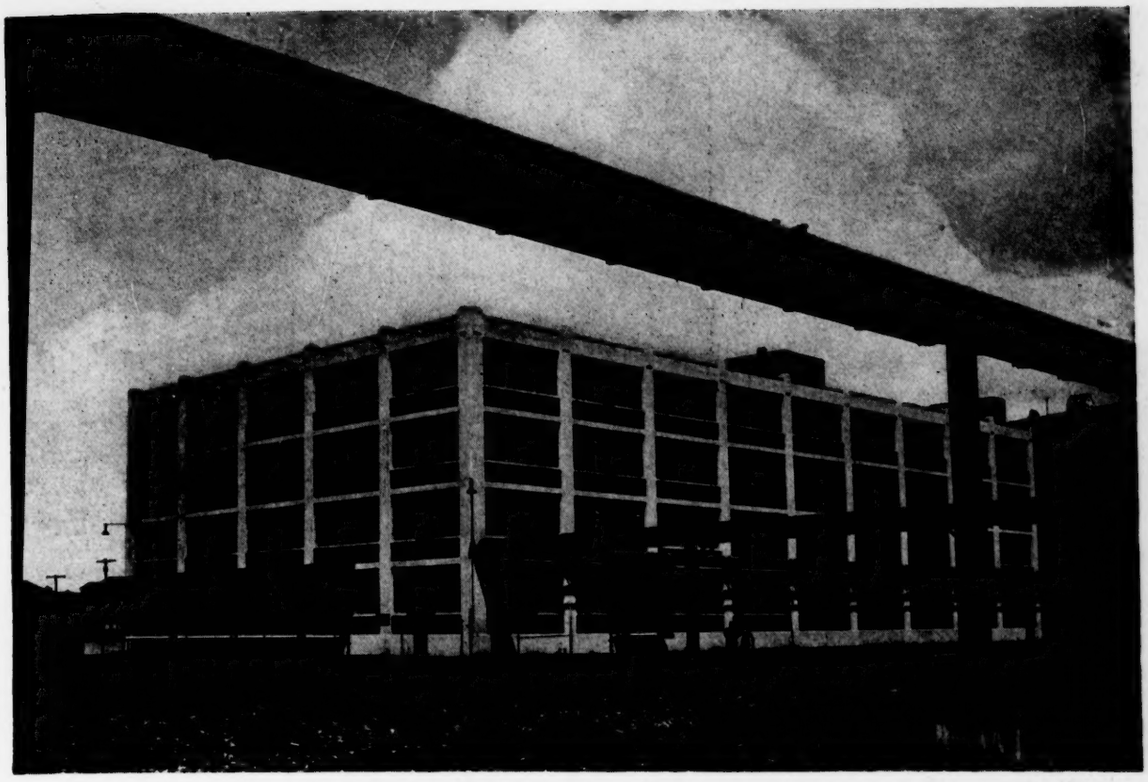

Agfa Ansco film warehouse, Binghamton, N. Y.

Air Conditioning at the Agfa Ansco Film Warehouse

By H. W. SACHS†

Photographic films and papers are extremely sensitive to atmospheric conditions and will deteriorate if placed in ordinary storage spaces. Because of this the new Agfa Ansco warehouse has been equipped with a conditioning system which can maintain 72F and 40 to 60% R.H. throughout the entire year. All of the outside air is filtered three times. Over 117 tons of cooling is obtained through the use of well water.

BECAUSE of the effect of temperature, moisture, and dust on the emulsions used on photographic films and papers, air conditioning is an absolute necessity in plants manufacturing such products. Even after the manufacturing process has been completed the emulsions used on the paper and films are affected by changes in atmospheric conditions. Because of this, such products change their photographic characteristics and must be used within a varying number of months after they have left the plants. To insure the purchaser against the possibility of receiving old films and papers all packages are dated. While this procedure protects the consumer, it makes it difficult for the manufacturer since dealers keep a small stock and order film only as needed. This means that the manufacturer would have to produce the film in widely changing quantities or else employ some means of storing the products so that they will not deteriorate.

It has been found that if the films are kept in an air conditioned atmosphere, age has only a slight effect on them and their life is greatly prolonged. Tests over long periods have indicated that the best conditions for storage require an air temperature of between 70 and 74F and a relative humidity of approximately 50 to 55%.

Therefore, when the Agfa Ansco Corporation constructed their newest film storage warehouse this year near their Binghamton, N. Y., plant they had a complete air conditioning system installed. The system was designed to maintain an inside temperature of 72F throughout the entire year with a relative humidity that would not fall below 40% during the winter nor rise above 60% in the summer. The outside design temperature for summer conditions was 75F wet bulb and

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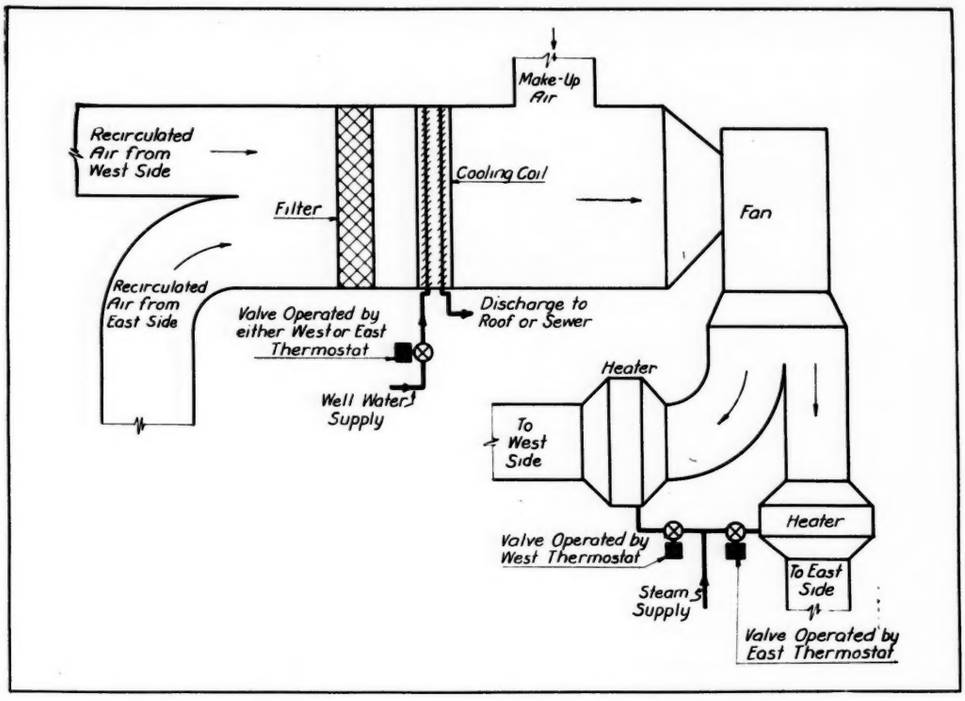


First floor conditioning unit which cleans and cools the recirculated air and mixes it with the makeup air supplied by the central conditioning unit. Steam coils in the distributing ducts heat the air during the winter.

90F dry bulb, while in winter the outside design temperature was —10F dry bulb.

One of the principal specifications was that all air delivered by the system was to be as nearly clean as possible. This feature was called for because of the danger of dust being carried back to the manufacturing plants through trucks, containers, and other means used for the transportation of goods between warehouse and factory. Since photographic products must be scrupulously kept clean, during both manufacturing and processing, it would not be advisable to deliver dusty packages to dealers and customers. Then, too, a high degree of cleanliness is maintained throughout all the buildings in the plant and it was felt that a clean warehouse would keep the idea of cleanliness before the employes.

Since there is a supply of well water available at a temperature of 52F all year around, it was decided to use this source of cooling in place of the usual condensing equipment. Calculations indicate that approximately 300 gals. of well water will be used for cooling. The refrigerating effect of the well water is equal to 117 tons of ice per day.

Building Construction

The warehouse was erected at a cost of approximately $265,000, is four stories high, has 72,000 sq. ft. of floor space, and a total interior volume of 920,000 cu. ft. A maximum of 50 people are employed in the building during working hours. The building has a concrete foundation with only a small basement which is used to carry the various service pipes. Exterior walls are constructed of 8-in. brick and 4-in. terra cotta tile with a 1-in. air space between. The roof is built up of 4½ in. of slab concrete, 1½ in. of cork insulation with an asbestos felt, pitch and slag waterproof finish on the top.

In designing the roof provisions were made so that the entire roof could be flooded in order to reduce the sun heat and cooling load on the building.

All of the windows are double sashed, both to reduce the heat load and to prevent the condensation of moisture on the windows during the winter when the outside temperature falls below freezing. In order to prevent the condensation of moisture between the two sheets of glass small peep holes are provided which allow a small amount of the outside air to enter the space between the glass. This feature allows the "air cushion" to balance with the vapor pressure of the outside air without cooling to a degree that would cause sweating on the room side of the window sash. Other provisions made to prevent the condensation of moisture on the interior walls include 1-in. cork insulation on all concrete beams above the windows and a 2-in tile terra cotta insulation on the inside wall of all outside columns. If this insulation were not applied there would be a considerable amount of moisture deposited on these cold surfaces during cold winter days.

As an experiment two sections of glass blocks were installed. The purpose of this experiment was to determine the exact cost of installation and also to determine the usefulness of these blocks in preventing sweating. While the building was in operation only during a small period of the past winter, there are indications that these blocks are successful in preventing sweating with an outside temperature of —10F and inside relative humidity at 40% at 70F. They also have the advantage over double sash glass in that no maintenance is necessary on steel sash.

The entire building is exceptionally well protected against infiltration since all windows are permanently sealed in place and cannot be opened. The loading doors have special sealing strips in order to keep them air-tight. During the unloading and loading of materials, while the outside doors are open, the main loading space is shut off from the rest of the building by a series of interior doors.

Air Conditioning System

Both the heating and cooling of the building is accomplished by conditioned air. One central plant is used to supply the outside or makeup air while four individual units, one located on each floor, are used to circulate and distribute the conditioned air to the building. The central unit conditions all of the makeup

air and supplies it to the individual floor units. These take the recirculated air from the floors, clean, cool, or heat it, mix it with the makeup air and distribute it to the ducts.

The outside air, which is approximately 20% of the entire air circulated, is drawn in through an outside wall grille into an air conditioning unit located in the room on the first floor. This air first passes through a preheater where its temperature is raised sufficiently to prevent freezing in the spray chambers.

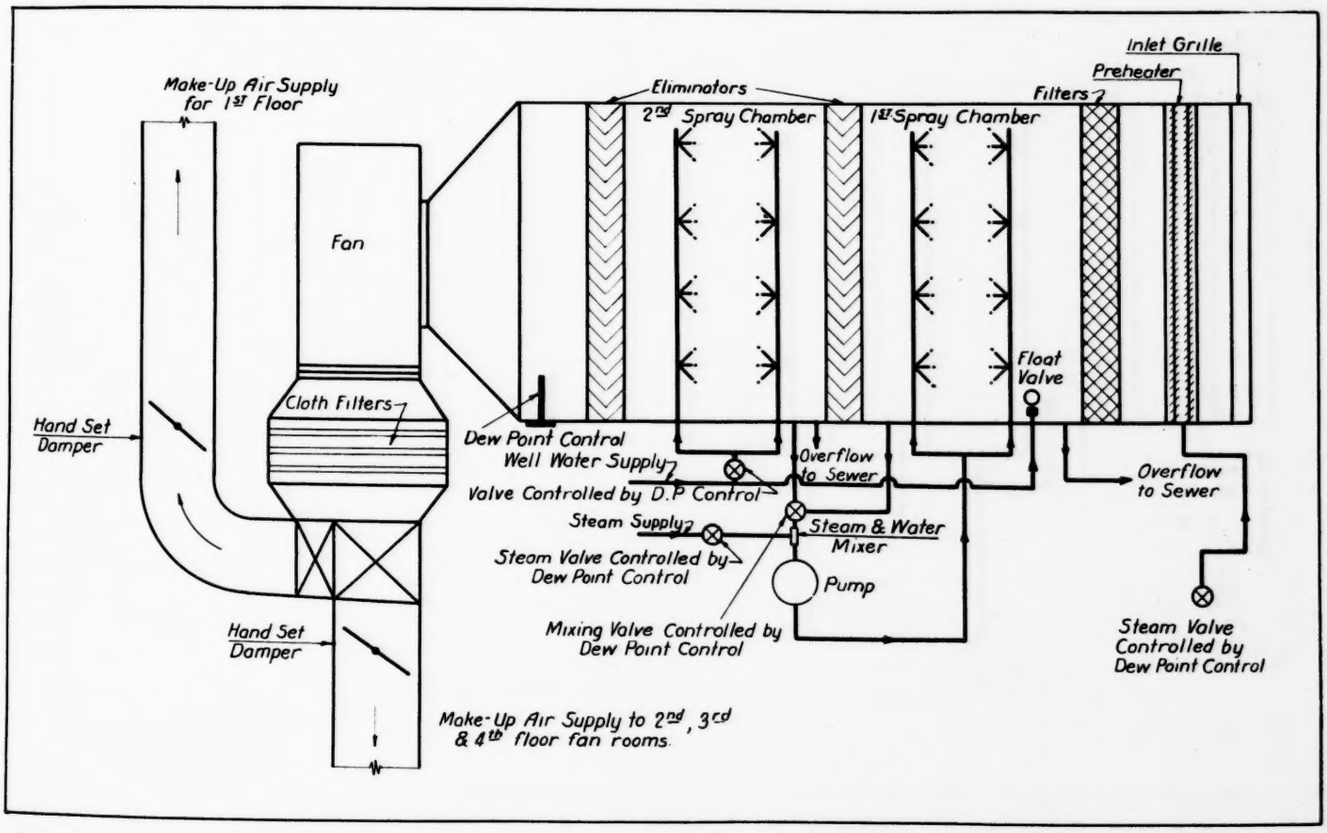
This preheater is so constructed that steam is evenly distributed throughout its entire surface so that there is no danger of freezing of condensate during extremely cold weather; this in spite of a floating control of the steam supply. During the summer, of course, and during other periods of the year when the outside wet bulb temperature is above the building dewpoint temperature the preheater coil is not in operation.

After leaving the preheater the air passes through steel wool filters impregnated with a viscous oil which removes the larger part of the dust. It then enters the first spray chamber. During the winter this spray chamber has the function of increasing the moisture in the air to the proper point so that the conditioned air which is discharged into the building has the correct relative humidity. During this period the water which is sprayed into this chamber is constantly recirculated by means of a small pump. Any makeup water necessary is supplied by a float valve from the well water system. The system is expected to add 150 gal. of water a day to air under maximum conditions.

On very cold winter days the preheater does not have sufficient capacity to warm the air up to the point called for by the dewpoint control. When this occurs a steam valve which is controlled by the dewpoint control opens and injects varying amounts of steam into the spray water. This raises the temperature of the water which in turn raises the air temperature. The steam valve is of the proportioning type and allows only enough steam to enter the water to bring the air temperature up to the degree called for by the dewpoint control.

On leaving the first spray chamber the air passes through eliminators which prevent carry over of water into the next stage. The air then enters a second spray chamber which is used only when it is necessary to do cooling. When cooling is required the dewpoint control opens a proportioning valve and lets varying amounts of cold well water at 52F into the sprays of the second chamber. The water from the drain of this chamber is mixed by a mixing valve, also controlled by the dewpoint control, with the water from the first unit and is forced by the circulating pump into the sprays of the first chamber. Thus, any well water admitted to the air washer is utilized twice before being discharged into the sewer. Eliminators behind the second chamber remove excess moisture from the air.

The air then passes over the dewpoint control and enters a fan of 12,000 c.f.m. capacity. On being discharged from this fan it is passed through a series of felt filters of the zig-zag type. It is then split up and carried by insulated ducts to the circulating air conditioning units located on each floor. In these circulating units the recirculated air from the floor is first cleaned, then cooled by means of a fin cooling surface, if necessary, mixed with the makeup air and is picked



Central air conditioning unit which conditions all of the makeup air. During the heating season the first spray chamber is used for humidifying while during the summer both chambers are used for cooling.

up by a fan, passed over heaters which operate in winter only and is then distributed by ductwork over the entire floor.

The three circulating air conditioning units on the second, third, and fourth floors are identical in construction while the one on the first floor differs only in that it utilizes return ducts to carry the circulated air from the floor to the conditioning unit. The ducts are necessary in this case because the unit is located in the main conditioning room which is entirely isolated from the rest of the floor and also because the first floor is subdivided into rooms while the other floors are not (except for the offices). On the second, third, and fourth floors the conditioning units are located in the rooms which are isolated only by means of wire screens and the recirculated air has free access to these places.

After leaving the heating units the air is distributed by the usual type of ducts throughout the entire floor. In most cases, however, there are large storage bins which would tend, because of their height, to interfere with the circulation of the air. To overcome this tendency, special types of air discharge outlets are provided on the ducts. The outlets project a high velocity air over the tops of the bins to a distance of approximately 20 ft. The air while traveling through this distance gradually falls and is distributed fairly evenly over the entire area.

There are three offices on the first and second floors of the building. Since the occupants of these offices would desire somewhat different conditions for their comfort than were to be maintained in the storage area, a special group of equipment supplies air to these rooms. This equipment includes a booster fan, one electric heating coil, and three steam coils. The booster fan picks up air from one of the main distribution ducts and discharges it separately to the three offices. Each one of the three distributing ducts has a steam heating coil for winter use.

Both the steam heating coils and duct dampers are cotrolled by room thermostats located in the offices. During the winter or in other periods of the year when steam is being supplied to the building and when the occupants of the offices desire a higher temperature than is maintained in the storage spaces, the steam heating coils supply the necessary heat. During the other periods of the year the damper control is used. The operation of the electric coil is controlled by a duct thermostat.

The booster fan which supplies air to the offices provides a greater air pressure within the offices so that there will be no infiltration from the storage spaces into these rooms. Undercut doors in the offices allow the air which is supplied to the offices to find its way back to the circulator units.

Any excess air in the building is discharged through window louvers with automatic back pressure dampers which are located in the toilet rooms. There is also a certain air loss through operation of the loading doors.

Dust Control

Since it is highly important that the dust in the air be kept at a minimum, all of the concrete floors have been subjected to a special treatment. The concrete flooring was placed on the slab after the building was enclosed. It was made up of a very dry mixture containing the hardest trap rock obtainable, was compacted with a floating machine and steel troweled five times. After curing thoroughly, a chemical hardener was brushed into the surface. This was followed with a treatment of hard floor wax. This makes an extremely hard and dustproof floor and makes cleaning easier.

To prevent any dust from lodging inside the ducts, all the interiors of the ducts have been painted with a glossy white enamel. In the ducts which are not large enough for a man to enter a special construction is used. This construction consists of a special section which is bolted into place in such a manner that it can be easily removed so as to allow a man to reach into adjoining sections for cleaning. In the larger ducts clean-out doors are provided so that all parts of the interior can be easily reached. Special care has been taken to seal all the joints in the ducts.

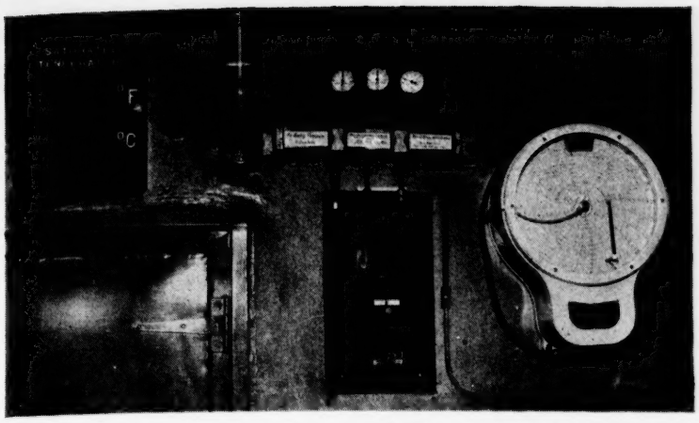
Control System

All of the controls are of the compressed air type, the compressed air being supplied by a small compressor and storage tank located in the air conditioning room on the first floor. Because of the arrangement of the equipment the relative humidity can be varied and controlled over wide limits. During the winter all of the moisture necessary to maintain the proper relative humidity is added to the makeup air in the conditioning unit on the first floor. During the summer the larger portion of the moisture is removed by the same apparatus.

Only one control unit is used to control the operation of the makeup air conditioning equipment. This is a dewpoint control which is placed between the second spray chamber and the fan; the device is manually set to give the dewpoint which is necessary to maintain the proper indoor relative humidity. The dewpoint maintained ranges from 45F to 60F. The entire control over the relative humidity in the building is obtained by this setting of the dewpoint control. The dewpoint control regulates the operation of the preheater, spray water steam heater, the well water in the second spray chamber, and the three-way valve or mixing valve which supplies water to the first spray chamber.

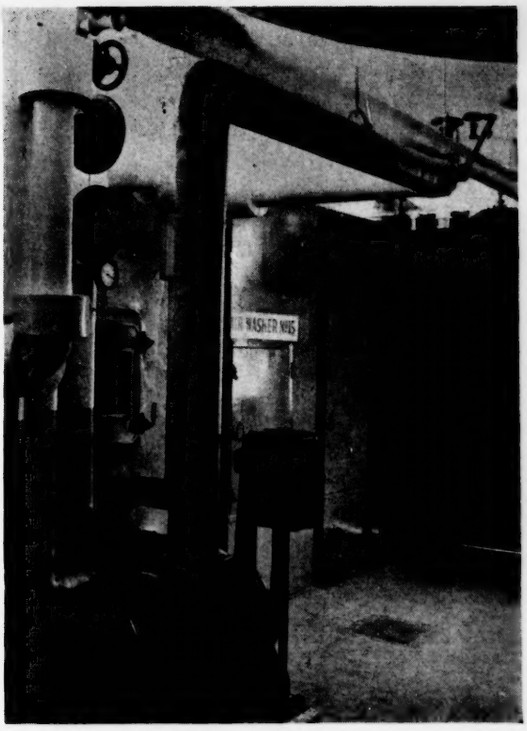
Thermostats control the operation of four air conditioning circulating units. There are two of these controls on each floor, one for the east zone and one for the west zone. These controls regulate the operation of the cooling coil and heating coils in the floor conditioning units and the dampers in the air distribution ducts.

During the winter a manual switch is thrown over to the winter position. This position opens the dampers in the distribution ducts and removes them from the control of the zone thermostats. The temperature in each duct is then controlled by the amount of steam allowed to flow to the heating coil. The steam valve on the heating coil in each duct is in turn controlled by the zone thermostat. During the early fall and late spring when the system is still on the winter operating

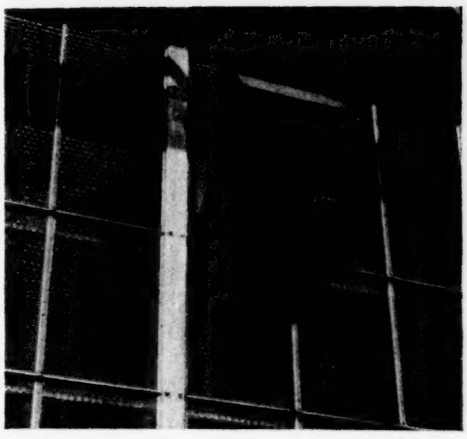


Control panel on central air conditioning unit. Discharge temperature wanted is marked on small black panel with chalk and controls are set to give this temperature.

AIR CONDITIONING DETAILS

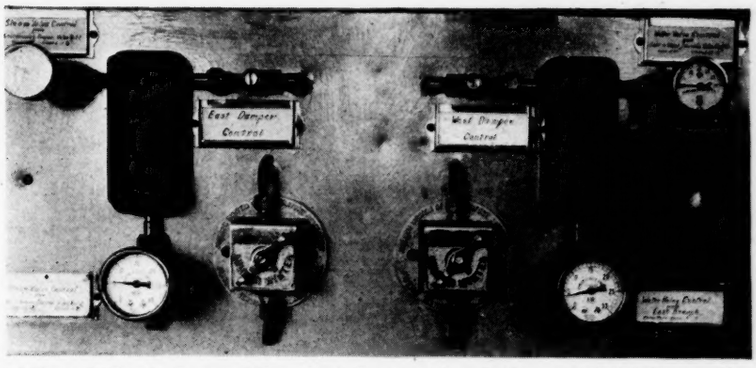


Central conditioning unit. Spray water circulating pump in foreground.



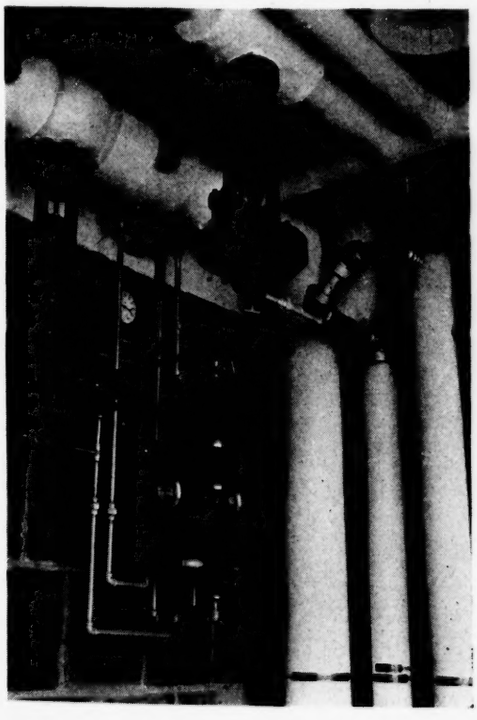
(Above) Window louvers discharge air from the toilet rooms. They are equipped with automatic back pressure dampers.

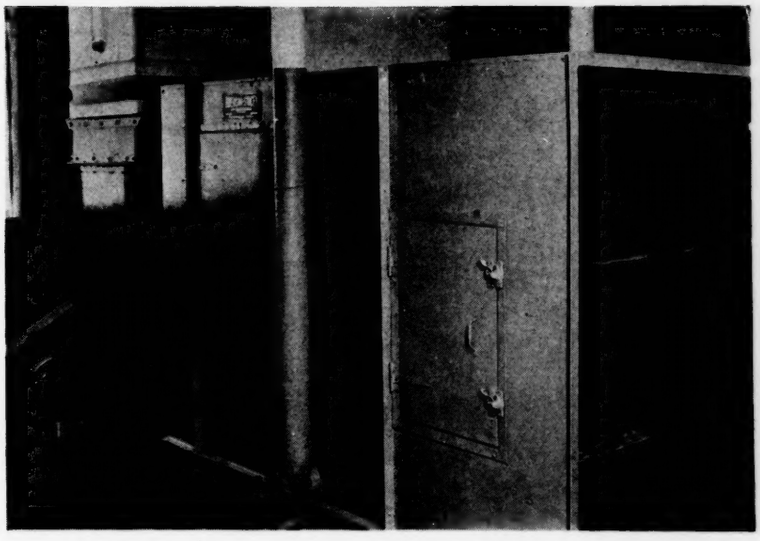
(Below) Steam reducing station which supplies steam for heating.



(Above) Control panel for first floor recirculating conditioning unit.

(Below) One of the recirculating conditioning units. Note steel wool filters on intake.





cycle there may be periods when the thermostat on the shaded side of the building is calling for heat and the thermostat on the sunny side of the building is calling for cool air. In this case the air is first cooled to the proper temperature as demanded by the zone calling for cold air and the air flowing through the duct to the zone controlled by the thermostat calling for warm air is heated by the steam heating unit. Thus it is possible to supply cold air to the one side of the building and warm air to the other to balance the effect of sun heat.

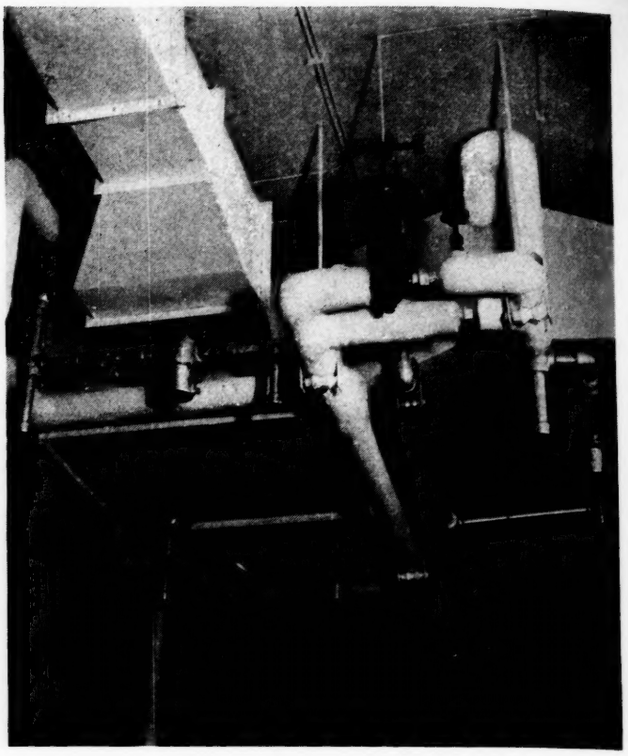
For summer operation the manually operated switch is thrown over to the summer position and the dampers then regulate the amounts of air distributed to the ducts. This is done because the cooling coil can supply only one temperature air to both ducts, and to supply different amounts of cooling to both sides of the building the amounts of the air must be varied. In other words, the temperature of the air from the cooling coil is determined by the thermostat which is calling for the lowest temperature. The damper in the duct, which sends air to the zone where the thermostat is calling for warmer air, will then close slightly and supply less air.

Steam Supply

Steam is supplied to the building from a central boiler plant which is located approximately ½ mile from the building. It is piped to the building in a pipe system having diameters from 10 to 6 in. supported on an overhead trestle insulated with 2½ in. of magnesia insulation.

Radiators and Heaters

Since no air is provided to the stairwells and elevator penthouse, and there is no air heat control for the toilets, radiators are placed in these locations. To take care of the infiltration loss when the delivery doors are open, five unit heaters are placed so that they face these openings. These unit heaters are operated by thermostatic controls and start up as soon as the temperature falls below that set on the control.



Branch ducts which supply conditioned air to the offices. Steam and electric heating coils are provided in these ducts so that a higher temperature can be maintained in offices than in rest of warehouse.

The air conditioning equipment in this building was supplied and installed by Buensod-Stacy Air Conditioning, Inc., and the control system by the Johnson Service Co. Lockwood Green Engineers, Inc., acted as consulting engineers for the building as well as for the air conditioning system and steam main.

Operating Personnel

K. Braun and Stephen Barcay are the plant engineers who have charge of the operation of the air conditioning installation in this plant and of all such mechanical equipment as can be classified as "energies."

Hay Fever Aided By Air Conditioning Unit

VICTIMS of hay fever and other respiratory affections are assured of a "high degree of benefit" from air conditioning today, as a result of a series of pollen tests by Prof. F. H. Hodgson, department of allergy botanist at Roosevelt Hospital.

Using a portable room cooler, Professor Hodgson conducted his tests in a room where the air was heavily saturated with dust and pollen.

Actual results in one of the main tests in a "room to be used by an allergic patient," Professor Hodgson said, showed the pollen count reduced in 10½ hr., from 1050 to 2 per square centimeter.

At regular intervals the amount of pollen remaining in the room was carefully counted on an exposed slide, Professor Hodgson reported. Four and a half hours after the experiment was begun, the pollen count had been reduced from 1050 to 70; three hours later, the count had dropped to 5; and, ten and a half hours from the start of the experiment, the count was only 2.

In a test conducted in a pollen-impregnated room, seven hours of using the air conditioner resulted, Professor Hodgson reported, "in a reduction of practically 99% of the pollens and 98% of the visible dust."

Professor Hodgson then ran a test under unusually extreme conditions where "a much heavier discharge of pollens and dust was blown into the room, the air thoroughly agitated and the unit turned on for five hours, this time without definite effort to keep the room closed except for windows."

Tests showed at the end of five hours, that in an unconditioned room the average pollens per square centimeter were 224 and the dust particles 175; while in the air conditioned room, average pollens per square centimeter were 10 and dust particles 22.

Conditioned Air—Its Opportunities and Problems

By EARL W. GRAY†

Utility companies have actively promoted the sale of air conditioning equipment in many localities. Here is a description of the plan followed by one of them in Oklahoma. The company prepares plans and draws specifications for the owner, cooperates with manufacturers, dealers, and distributors, advertises locally. The author described this plan in an address before the 5th annual convention of the Edison Electric Institute, held in Chicago in June, 1937.

BEGINNING in 1933 our company has aggressively promoted the addition of air conditioning load to our lines. We now have 490 air conditioning and air washing installations, totalling 6600 hp. We consider this good business to have and want more of it.

Our system extends from western Arkansas a distance of 380 miles across Oklahoma to the Texas border on the west, equivalent to the highway mileage from Philadelphia to Cleveland. It also extends 210 miles from the northern to the southern boundaries of Oklahoma. We serve 238 communities with a total population of 638,000, of which 225,000 is in Oklahoma City, where our general office is located. Four of our cities are from 25,000 to 35,000; eight from 10,000 to 15,000; 12 from 3000 to 8000; and the remainder graduate down to the smallest village.

Our commercial department, outside of the general office, consists of a commercial manager with one or more assistants in each of seven division offices, including one in Oklahoma City. It was obvious that the potential air conditioning business would not justify a specialist in each division, and as the division offices are from 40 to 200 miles from the general office, it was not practicable for a specialist to go out on every job. Therefore, the division commercial managers have made a study of air conditioning and, with the aid of a specialist in the general office, have conducted our air conditioning promotion.

In the beginning we had difficulty because there were no experienced firms to sell the equipment. Consequently, when we did get a customer sufficiently interested to ask for bids he received such a variety of opinions as to the necessary capacity and the method of installation that he concluded none of the bidders knew what they were doing, threw up his hands and decided to wait until the art was better developed.

When we asked for bids on equipment for the first air conditioning installation in our own building, it was forcibly demonstrated to us that many of those selling equipment were somewhat at sea. It was evident from this experience that we would have to take the lead in both promotion and engineering, by acting as consultants for our customers and dealers.

Fortunately, we had as the head of our mechanical and structural design engineering department a man who had not only had years of experience in ice plant design and erection but also had made a study of air conditioning. He was assigned the task of developing his department to handle the detail engineering and writing of specifications for those jobs that the commercial department considered worthy of such service. This plan has been followed through and has given excellent results. The revival of business has made it necessary to increase the personnel of the engineering department, and new men have been chosen with close attention to previous training and experience that fitted them for air conditioning work. Under this arrangement with the fluctuation of the air conditioning season, as many men as are needed are available for assignment to air conditioning engineering, and only the actual time used is charged against this promotion. The rest of the time these men are busy on the general run of work handled by the department.

The division commercial manager develops his prospect and gives him an approximation of the capacity required, installation cost, and operating cost. If the customer requests specifications, a survey is made and specifications are furnished which give the capacities necessary, a general description of the equipment, and a suggested method of installation.

In the preparation of specifications, standards are used which are a compilation of the best data available. The specifications are written so the equipment of any reputable manufacturer may be used. A check is made by the distribution engineering department to determine the service facilities available at the given location, and this, together with a determination of the rate application, enables us to designate in the specifications whether single or three phase motors shall be used, permissible starting currents, and the metering arrangement.

Many of the pages of the specifications are identical for certain classes of jobs so that, with the routine that is set up, the complete blueprinted specifications are turned out in a very short time. Usually eight copies of the specifications are delivered to the customer by the division commercial manager, together with an esti-

†Commercial Department, Oklahoma Gas and Electric Co., Oklahoma City, Okla.

mate of the cost of operation when added to his present usage. He is also furnished a list of the air conditioning firms in his territory and urged to ask for bids.

There is something psychological about a blueprint that gives the customer confidence and influences him to go ahead with the purchase of equipment. We have frequently found that a hesitant prospect could thus be influenced to ask for bids.

We are in no sense in competition with consulting engineers. In fact, on many jobs we recommend that an engineer be retained. This phase of our work is limited to the smaller jobs where the customer will not retain an engineer, but is reluctant to go ahead with the purchase of equipment about which he knows nothing.

It has always been our purpose to reduce the amount of engineering service furnished just as rapidly as the distributors of equipment built up competent organizations. We now have a number of excellent companies in our territory and, to aid in building them up, we find it necessary to curtail the amount of engineering assistance furnished dealers.

Obviously, if a distributor plays the game and employs engineers, he operates under a much greater overhead than the firm which does not have an engineer and depends on the utility to do all of the engineering. Therefore, we have discontinued making surveys or doing other detail engineering for dealers, and do this type of work only on the direct request of the customer.

Of course we do advise with the dealers and help them as much as possible as long as we can do so without showing any favoritism. We are proud of the cordial relations that exist between these men and our company.

The utilities are not the only ones who have had problems. The manufacturers have had their share, and one of the most trying has been the difficulty of finding satisfactory outlets. In many instances distributors of household refrigerators undertook the distribution of air conditioning equipment with their regular dealers as sales outlets. They soon learned that this was a new type of business and that, although their entire organization and training had been centered on merchandising, they were now in the contracting business, a highly specialized one at that. They found that instead of specialty salesmen they had to have sales engineers as well as design and installation men who added heavily to their overhead.

Furthermore, they found that their dealers could not afford to hire men trained in air conditioning so could do little more than advise the distributor of any prospect and leave it up to him to engineer and sell it. This added to the selling expense of the distributor and, by the time he included a profit for the dealer, he could not compete with the distributor or manufacturer who was selling direct. The local dealer did not get very enthusiastic about trying to make air conditioning sales when he found that it took so much time to make one sale and he knew that he could make more money selling refrigerators. It became evident there wasn't much place in the field for the dealer, as far as commercial air conditioning was concerned.

The manufacturers have realized these difficulties and in many cases have divorced air conditioning from household refrigeration. Where possible, they have appointed distributors whose sole interest is air conditioning or who at least are in contracting lines. These firms operate as distributor dealers, working the territory and selling direct and, where possible, setting up local dealers to handle their self-contained units and turn prospects for larger jobs to the distributor.

Manpower is the greatest need of the distributors at present. They are unable to secure sufficient men with the proper background for sales engineering, and skilled mechanics, particularly sheet metal men, are at a premium.

The promotion of residential air conditioning had an uphill climb at the start. In our territory with an abundance of 1000 B.t.u. natural gas selling at around 45 cents per thousand cubic feet, we have the ideal fuel for winter air conditioning, but a larger percentage of our homes use open gas fires or floor furnaces and have no basements, and in many cases no flues. Under these conditions, the idea of year-round air conditioning was difficult to sell.

The revival of residential construction last year brought several surprises. We found that the educational work on air conditioning was bearing fruit. The home builders wanted comfort in their new homes. Practically all of the better class homes now being built are fully insulated, which makes them better prospects for air conditioning.

The room cooler offers the medium for volume sales of air conditioning. It is something that can be handled by the dealer in the small town and sold with a minimum of sales expense. The manufacturers have prepared survey forms with which in a few minutes the salesman can determine whether his room cooler is applicable or whether larger equipment is required. The dealer is doomed to failure who, instead of giving his salesmen some training in the fundamentals of air conditioning, starts them out with the idea that his cooler is good for so many square feet of floor space and that fresh air is a non-essential. Too often we have seen them applied in this hit or miss fashion, with the consequence that the customer was so displeased with the results that he condemned air conditioning in general.

Room cooler installations present problems that must be given attention. The tendency has been to sell them as socket appliances, but we know that motors of the size necessary in the larger models will not generally operate satisfactorily on 115 volts because few of our older buildings have circuits larger than No. 14 wire. Some dealers think that the utility is unusually severe in requiring that motors above ½ hp. be operated at 230 volts. After a few experiences with motor trouble and after we have convinced them that we are furnishing full voltage at the entrance, they decide that there may be a reason for such a requirement. Unfortunately, some of the manufacturers are shipping out machines built only for 115 volts, with no provision for reconnection. The horsepower rating is not an index of the power input as we find room coolers with ¾-hp. motors having an input of 1250 watts. Other air cooled room coolers have a total input for compressor and fans as high as 1500 watts.

Interest in attic ventilation continues, and many installations have been made throughout the south and middle west. Attic ventilation undoubtedly has an important place in a well-rounded program, but we should not, because of a price complex, lose sight of the greater benefits to be had with air conditioning.

Evaporative cooling is another load that has gained impetus under the public demand for cooling. The ordinary evaporative cooling system consisting of a washer, circulating pump, and a squirrel cage fan, does not control the humidity. It will give effective cooling without uncomfortably high humidities only in those localities where the wet bulb temperature is moderate. This condition obtains on a part of our system, and the air washer fills a real need in applications where some measure of cooling without humidity control is desired. In some cases, such as the small theater without prospect of sufficient revenue to justify the owning and operating cost of air conditioning, an air washer is the only answer.

The future is limited only by the extent of our own efforts. The desire for air conditioning is here. It is our job to remove the mystery and crystallize desire into action and additional revenue.

Use of Air Conditioning in Textile Plants

ECONOMY and protection of the health of the worker were named by L. Logan Lewis, chief engineer of Carrier Corp., Newark, N. J., as the main functions of textile air conditioning.

In an address before the Rayon Technical Conference commemorating the 25th anniversary of the manufacture of rayon in the United States, Mr. Lewis pointed out that air conditioning got its start in the textile industry because manufacturers found they could turn out a better product at less cost.

Purposes of air conditioning in textile plants devoted to the manufacture of synthetic yarns were listed by Mr. Lewis as:

1. Controlling the rate and extent of chemical reaction.
2. Protecting the worker from harmful byproducts.
3. Fixing the regain, and hence, certain physical properties of the product.
4. Improving the efficiency and health of the worker.

Mr. Lewis then took up, step by step, the various processes in the manufacture of synthetic yarns and analyzed their air conditioning needs. These steps are:

Viscose Process

Step 1—*Raw Material Storage.* Heating only is required for the storage space.

Steps 2 and 3—*Steeping and Shredding.* Steeping requires no air conditioning. Shredding—the general practice is summer air conditioning, to maintain an absolute humidity.

Step 4—*Aging.* A system embodying only the elementary function of heat removal with regard to humidity is applicable.

Step 5—*Xanthating or Churning.* In the practice of conditioning churn rooms, it has long been recognized that maximum freedom from the explosion hazard requires continuous introduction of a relatively large volume of outside air. Practice has established an air change of approximately 20 times per hour. All air supplied to the churn must be taken from outdoors, conditioned and then wasted.

Step 6—*Ripening.* Refrigeration of the utmost reliability is essential, for if the solution rises above a certain critical temperature, coagulation will destroy its value as a spinning solution.

Step 7—*Spinning.* The purposes for which air conditioning is needed in this process are manifold. Evaporative cooling is essential, with great emphasis on dissipation of the gases generated by the chemical reaction in the spinning process, thus eliminating the chance for irritation to the lids and eyeballs of workers.

Step 8—*Cake Storage.* The problem is one of winter air conditioning.

Step 9—*Reeling and Lacing.* Evaporative cooling equipment is required; good air distribution is required, with air motion limited by the delicacy of the threads.

Steps 10 to 14 inclusive—*Washing, drying, desulphurizing, bleaching, and centrifuging, final drying, and conditioning.* Except for the drying process, the need for air conditioning is limited to heating, in the design of which some consideration must be given to the vapors arising from washing operations.

Evaporative cooling is required for the regain section of the dryer.

Step 15—*Grading and Sorting.* Comfort and efficiency of the worker becomes an important factor in this process just as it is important in preceding steps.

The air conditioning equipment must have a high cleaning efficiency and the system must embody all of the functions of the year-round air conditioning.

Step 16—*Warping, Winding, and Quilling (processing).* Best results are obtained with year-round air conditioning holding 80F and 55% relative humidity.

Acetate or Celanese

Air conditioning problems presented by this process are quite similar to those of the viscose process.

Up to spinning, the rates and limits of chemical reactions must be controlled by the regulation of temperature almost without regard to relative humidity. Acetic acid fumes must likewise be kept under control to guard the health of the employee.

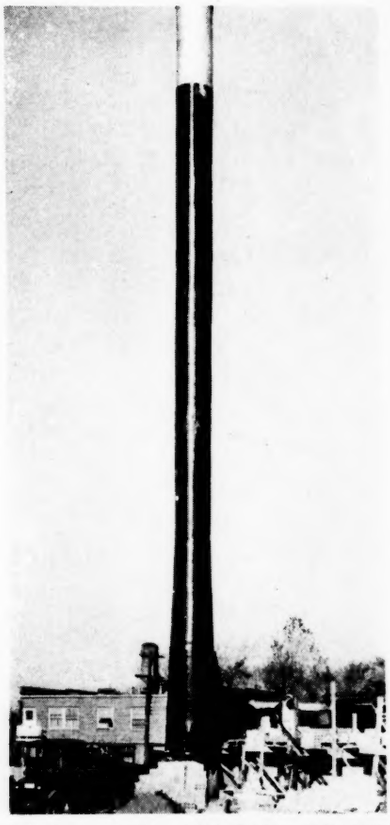
Weaving and Other Uses of Yarns

Year-round air conditioning to which refrigeration is essential, is not economically practical because of the large internal heat gain for the average weave room, and the comfort conditions which can be maintained with evaporative cooling improve as the relative humidity is raised.

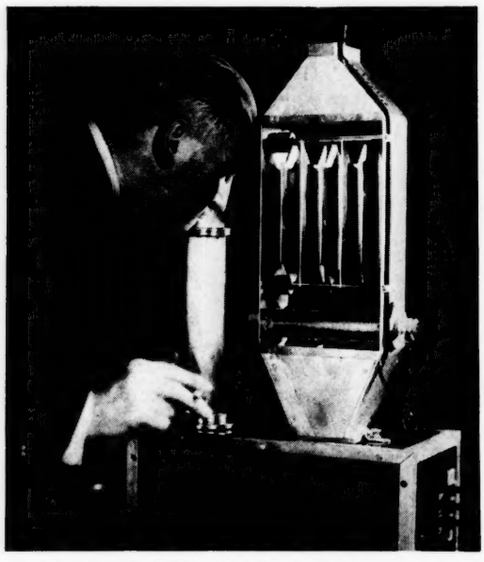
Constant relative humidity is very important.

PICTURE PARAGRAPHS

GENERAL ELECTRIC COMFORTER, a light bed-covering intended to replace heavy blankets. Heated by low voltage wires; thermostatically controlled.



90-FT. ARC WELDED STACK, largest self-supporting structure of its kind in Ohio. Built by Ohio Machine and Boiler Co., Cleveland, with G-E arc welding equipment.



ELECTROSTATIC AIR CLEANER removes smoke from air as demonstrated by Dr. Phillips Thomas, Westinghouse research engineer.

HUGE MINE VENTILATING FAN for Glen Alden Coal Co. Fan was made by Buffalo Forge Co.

(Left) **ROYAL PALACE AT TEHERAN,** Iran, is cooled by hand-propelled fans. Tower at left is intake for fresh air. Photo by Galloway.

Building Heating and Cooling Requirements Reports Feature ASHVE Summer Meeting

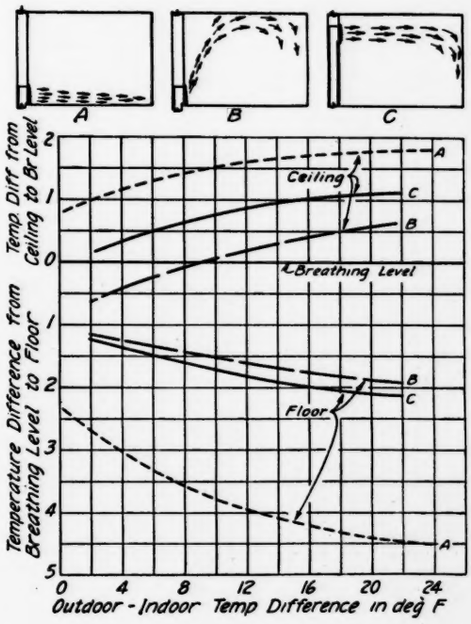
RETURNING to Swampscott, Mass., after a period of six years, the summer meeting of the American Society of Heating and Ventilating Engineers (June 24-26) attracted an attendance of 380 members and their guests. With the meeting located in this center of summer vacation attractions and historic spots, the social side of things was to the fore with boat trips and museum visits for the ladies and golf for the men. As an innovation also the meeting took place on the closing days of the week with the final session on Saturday morning. In spite of the other attractions attendance at the technical sessions held each morning was substantial and speakers received close attention.

"The Adaptability of Precooling Coils to Air Washer Systems" was the title of the first paper on the program. The author was John Everetts, Jr. Due to Mr. Everetts' absence the paper was presented by Walter Fleisher. Conclusions reached by Mr. Everetts were that (1) The combination of precooling coils and an air washer gives the accumulated advantages of each and none of the disadvantages to a system where exact year-round control is required; (2) Use of coils alone will not give a control of the delivered dewpoint unless the entering dewpoint is higher; (3) The use of an air washer alone is limited in cooling capacity and under certain conditions cannot carry the load unless multi-staging is used; (4) The combination of cooling coils and air washer eliminates these two major objections, and gives positive year-round control of air conditions.

Summer Degree-days

A paper entitled "How Much Power Will an Air Conditioning System Use," prepared by Anson D. Marston of the Kansas City Power & Light Company, and read by S. S. Sanford in Mr. Marston's absence, referred to the degree-day which is used by the heating industry for estimating heating costs, and then described the use of the number of degree-days above 65F as a similar unit useful in summer air conditioning work. In his paper Mr. Marston pointed out that one of the reasons why so little information has been available on the subject is that accurate energy consumption records of summer air conditioning jobs are not widely available. In his study he used the power consumption figures for Kansas City for three years from 1934-36, grouping them into two classes—residential and commercial. Mr. Marston prepared a chart which showed that the energy consumption by summer air conditioning systems is substantially proportional to the difference between 65F and the average monthly temperature when the temperature is above 65F. However, the figures for those months with average temperatures below 65F deviate considerably from this relationship, which is to be expected, for many months with low average temperatures contain periods of a week or more of hot weather with consequent great use of cooling equipment. Additional studies indicated to the author that the relationship was based on use of 65F; he had felt that the base should have been 70 or 75F and further studies were undertaken as a verification. The complete studies showed that the variation in energy consumption was excellently correlated with the number of degree-days above 65F for 1935 and 1936 but had poor correlation for 1934. In his opinion, however, poor correlation in 1934 may have been due to the fact that few customers were on the lines of the utility in that year.

The factor of relative humidity was neglected entirely in the investigation. A compilation of days with outside wet bulb temperature equalling or exceeding various values was studied with the idea in mind of seeing if there was any relationship between these figures and energy consumption. No well-defined relationship between relative humidity and energy consumption was found.



Room air temperatures with three types of registers according to studies made at the University of Illinois as reported by Professor Kratz and Messrs. Konzo and Broderick.

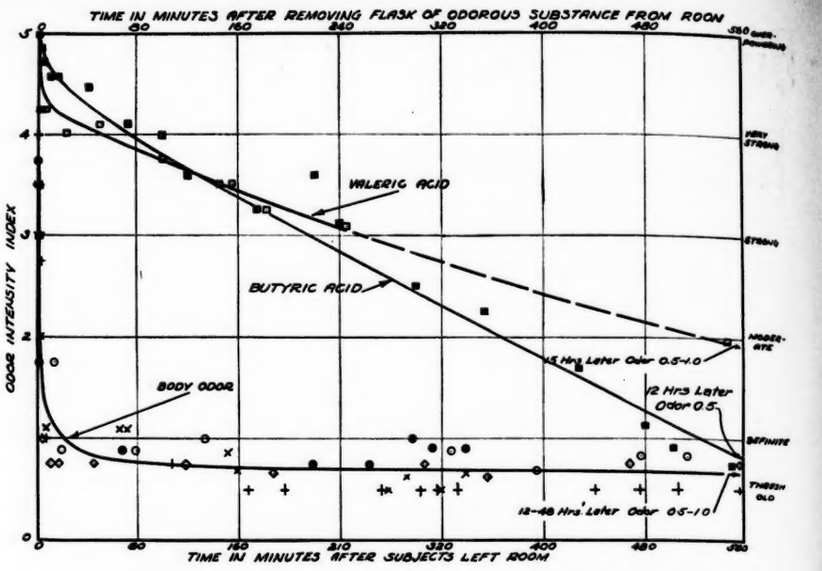
While use of degree-days above 65F can be made with assurance in connection with summer air conditioning in Kansas City for commercial customers, the relationship was not so good with residential customers; with this type of air conditioning a base on 70F was found to give better correlation. Due to the limited number of residences studied and the fact that families which can afford summer cooling take extended summer vacations, with consequent non-use of the cooling plant, there is some doubt about any conclusions being valid for residential customers.

Cooling Calculations

A study of load factors of solar radiation and infiltration; practice in determining cooling load requirements, and safety factors in connection with summer cooling were some of the subjects

discussed in an excellent paper entitled "Cooling Load Analysis of a Bank Building," by John James of ASHVE headquarters, in which Mr. James surveyed 27 states and several provinces of Canada. A plan and brief specifications of a banking space were sent to engineers throughout these areas asking them to fill in the calculation sheet showing individual determinations of the sensible, latent and total cooling loads for the building under consideration in the territory of each person receiving the questionnaire. Significant items were requested in the statement of conditions assumed. Forty-seven complete calculations were returned.

Mr. James' conclusions follow: With the calculated cooling loads varying from 5.23 to 12.7 tons of refrigeration for the banking problem and with a resulting average of 8.33 tons, it was found impossible to classify the loads for the various cities according to any territorial grouping.


TIME IN MINUTES AFTER REMOVING FLASK OF ODOROUS SUBSTANCE FROM ROOM
ODOR INTENSITY INDEX
VALERIC ACID
BUTYRIC ACID
BODY ODOR
15 Hrs Later Odor 0.5-1.0
12 Hrs Later Odor 0.5
12-48 Hrs Later Odor 0.5-1.0
TIME IN MINUTES AFTER SUBJECTS LEFT ROOM

Disappearance of body odor and of odors of valeric and butyric acid, in a closed room.

The design outside and inside temperatures used checked closely with recommended values given in *The Guide* with some exceptions.

A majority of the computations employed *The Guide* method with variations for determining the solar radiation effects, but several rational procedures were also used which considered actual solar intensities and the nature of the surface.

The greatest variables were found in the methods adopted for estimating the amounts of uncontrolled infiltration and controlled ventilation air. The analysis indicated that a majority of load determinations considered a positive pressure in the enclosure with air introduced in the amounts of 10 to 15 c.f.m. per person.

The results of this survey show clearly that with the different calculation methods now in use it is practically impossible for engineers even in the same locality to appraise the total cooling load on a comparable basis within close limits.

Well Water Cooling

A study of summer cooling was carried on in the Research Residence at the University of Illinois during 1935 using water for cooling with water temperatures from 58 to 60F. In 1936 similar studies were undertaken to determine to what extent water at temperatures of from 46 to 52F could be used to produce satisfactory cooling in the residence when supplemented by outdoor air at night in the second story and with one air change per hour for ventilation during the day. A report on this 1936 study entitled "Study of Summer Cooling in the Research Residence Using Water at Temperatures of 52F and 46F" was presented by Prof. A. P. Kratz, S. Konzo and E. L. Broderick, all of the University of Illinois. The paper was read by Mr. Konzo.

The study showed that when using water at temperatures from 46 to 52F it was possible to maintain a dry bulb temperature indoors at 80F when it was as high as 108F outside. When the outdoor temperature exceeded 90F the plant operated continuously for considerable periods and it was possible to maintain an indoor relative humidity of 52% with a resultant effective temperature of 74F. This would undoubtedly be acceptable to the majority of users.

When the outdoor temperature was not high and the cooling plant was operating intermittently the relative humidity inside rose to maximum during the off period. The magnitude of the rise, the investigators found, is dependent largely on moisture content of the outdoor air. However, when the temperature outside is high and the cooling plant is operating continuously the relative humidity inside decreases to a minimum value which is independent of the moisture content of the outside air and is related to the mean coil temperature. Oddly enough, and possibly by coincidence, the numerical value of the relative humidity maintained in the house was nearly the same as the numerical value of the mean coil temperature.

Studies were made by the investigators of two possible methods of calculating what the cooling load would be hour by hour. One method was based on summing up the total cooling loads from all possible sources, assuming no heat lag, whereas the second method attempted to take into account the heat lag. The conclusion reached was that in the case of uninsulated frame houses, such as the Research Residence, the rather complicated method for calculation of the maximum value of the cooling load based on including the heat lag is possibly not justified.

The authors presented an interesting table showing the calculated values of the cooling load from the different sources in the Research Residence. Since the Research Residence is, and was intended to be, a typical house the figures are of value. See Table 1.

"Calculated Over-all Coefficients for Walls with Air Space Insulation" was the subject of a paper by Prof. F. B. Rowley, University of Minnesota. The over-all coefficient of heat conductivity U can be calculated knowing the thermal properties of the materials if the

TABLE 1.—HEAT GAIN DISTRIBUTION IN RESIDENCE

Source of Heat Gain	Per Cent of Total of Maximum Values
Walls, not exposed to sun	24.2
Walls, exposed to sun	8.2
Windows, not exposed to sun	20.9
Windows, exposed to sun	8.4
Ceiling	22.3
Floor	—4.1
Ventilating	12.7
Occupants	3.8
Motors	2.9
Lights	0.7
Total of maximum values	100.0

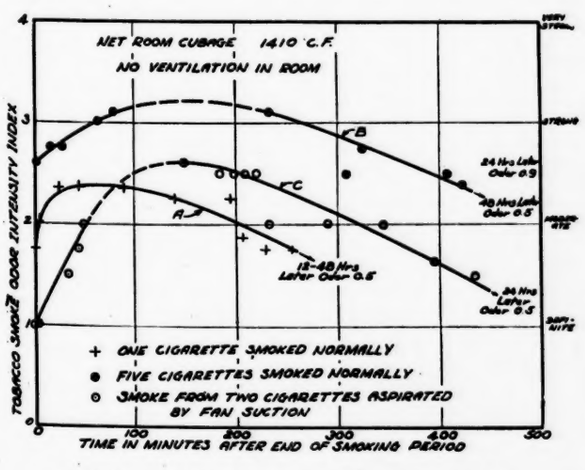
materials are placed uniformly over the full area of the wall. However, when insulating materials are placed between the studs of a frame wall, for example, heat passing through the walls does not pass through equal thicknesses of all materials and the over-all coefficient U differs from point to point. A study of different walls from this standpoint was made by Professor Rowley.

Prof. G. B. Wilkes and C. M. F. Peterson, both of Massachusetts Institute of Technology, presented a paper on "Radiation and Convection Across Air Spaces in Frame Construction." The purpose of this paper was to restate the fundamental laws of radiation and convection and to give new experimental data on rate of heat transfer across air spaces bounded by good and poor reflectors of radiant heat.

Radiators and Convectors

"The Cooling and Heating Rates of a Room With Different Types of Steam Radiators and Convectors" was the subject of an investigation reported by Prof. A. P. Kratz, M. K. Fahnestock and E. L. Broderick, all of the University of Illinois.

The objects of the investigation were: (1) to determine the influence of different types of direct steam radiators and convectors on the rate of cooling of a room under winter service conditions after the steam supply to the heating units was turned off; (2) to determine the influence of different types of direct steam radiators and convectors on the rate of heating the same room from a stated minimum temperature after the steam supply to the heating units was turned on; (3) to correlate the results with the physical characteristics of the heating units.


NET ROOM CUBAGE 1410 C.F.
NO VENTILATION IN ROOM
TOBACCO SMOKE ODOR INTENSITY INDEX
TIME IN MINUTES AFTER END OF SMOKING PERIOD
+ ONE CIGARETTE SMOKED NORMALLY
• FIVE CIGARETTES SMOKED NORMALLY
○ SMOKE FROM TWO CIGARETTES ASPIRATED BY FAN SUCTION

Rate of disappearance of tobacco smoke in a closed room.

The conclusions of the authors were that a room can be heated to the same temperature at the 30-in. level with less steam when convectors are used than when direct radiators are installed. However, the equivalent temperature produced by convectors is from 1.3 to 2.2F lower than that produced by radiators and any saving in steam consumption is offset by less comfortable conditions in the room. The rate of cooling of a room is materially influenced by the amount of heat installed in the unit when the steam is turned off.

For the units tested in this work the rate of cooling was greatest with nonferrous convectors, less with cast-iron convectors, and least with direct radiation. The rate of cooling is also greatly influenced by the heat capacity of the materials in the building, the evaluation of which is difficult and uncertain. The thermal energy of the steam in the unit when the steam is turned off has no effect on the rate of cooling in the room. Under the venting conditions maintained in these tests air in the steam space was expelled and heating surfaces attained full operating temperatures up to five minutes after steam was turned on. Under such conditions the rate at which the room heats is independent of the masses of the heating units but dependent on the capacities of the units and their effectiveness in emitting heat.

Arthur Nutting, chief research engineer, American Air Filter Company, Inc., described "An Alternate Method of Comparing the Dust Arrestance of Air Cleaning Devices." Mr. Nutting said that use of the ASHVE Standard Code for Testing and Rating Air Cleaning Devices in general ventilating work has indicated it to be probably as practical for general testing as any single code can be. However, for particular types of filters he pointed out certain exceptions to the code which could be made and which would probably render it more applicable.

Odors Studied

At the Chicago convention of the ASHVE in 1936, research at the Harvard School of Public Health dealing with ventilation requirements was described. In that study reported it was found that the number of persons occupying a room was an important factor affecting the amount of outdoor air necessary for control of body odors. Subsequent findings at Harvard were reported at Swampscott in a paper entitled "Ventilation Requirements—Part 2" by Prof. C. P. Yaglou and W. N. Witheridge, both of the Harvard School of Public Health. The later work revealed two important factors responsible for variation in various rooms—spontaneous disappearance of body odors with time, and changes in efficiency of ventilation and odor removal with changes in the amount of air supplied.

An arbitrary scale was set up by the investigators to indicate the odor intensity: zero, no impressionable odor; ½, the threshold of odor detectability; 1, readily detectable but not objectionable; 2, becomes more disagreeable, little or no objection, allowable limit in room; 3, objectionable; 4, disagreeable; 5, violent.

Evidence obtained during the past two years indicates that all odors are unstable and disappear rapidly with time. Tests showed that the strength of body odor in a room fell abruptly from an index of 3.5 and 4 to the allowable intensity of 2 in less than four minutes after the subject left the room. Twenty minutes later the odor index was 1.

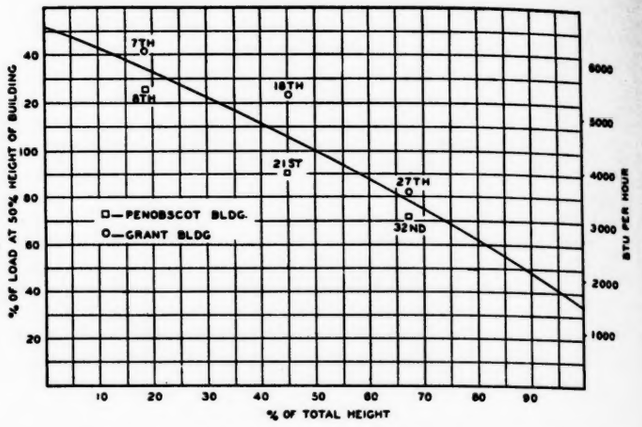
The rapid loss of body odor may be a characteristic of body odor itself, according to other studies on the disappearance rate of stronger odors such as valeric and butyric acid, tobacco smoke and ozone. With valeric acid, for example, the odor index fell at almost a constant rate from 5 to 2 in 560 minutes after the odor source was removed. Tobacco smoke disappearance characteristics were also studied. When one cigarette was smoked normally the odor index reached a maximum about fifty minutes after smoking was begun and dropped off to an index of 1½ after five hours. Unlike body odors the odor of tobacco smoke not only remained longer in the room but its intensity increased following the smoking period. The rise in odor intensity after smoking seems to agree with common observation that the odor of stale smoke is more offensive than fresh smoke perhaps due to alterations in its physical characteristics when passing through the respiratory tract.

Studies of ventilation efficiency were made, the efficiency being the ratio of effective air supplied to the total air supplied. With air flows under 5 c.f.m. per person average efficiency was practically 100%, decreasing after the air supply increased. With 30 c.f.m. per person the efficiency was about 75%. It would seem that the rate of air supply is more significant than the number of occupants in a room but the data were too few to draw a definite conclusion as to this. From the studies it was concluded that large rooms have an advantage over small ones as they act like reservoirs allowing body odors to disappear with a minimum outdoor air supply and maximum ventilation efficiency. On the other hand from the standpoint of tobacco smoke control the rooms should be as small as practical and ventilated as rapidly as possible.

Heating Requirements

The various factors entering into the heating requirements of a building including solar radiation, wind and stack effect, make the problem of estimating total heat requirements a difficult one. The ASHVE Research Laboratory has been carrying on projects on this subject for the past several years and at Swampscott a paper entitled "Heating Requirements of an Office building As Influenced by the Stack Effect" was presented by F. C. Houghten and Carl Gutberlet, director and research assistant, respectively, of the Research Laboratory. The study was based on a collection of data from the Grant Building in Pittsburgh during the heating season of 1933-34. The conclusions follow:

The study in the Grant Building indicates a considerable decrease in heat requirement with elevation in a building, indicating not only a complete absence of heat loss by infiltration in the upper floors, but also an actual decrease in the transmission loss due to the outflow of warm air through windows and walls.



Relation between the elevation in the building as expressed in per cent of the total height, and the heat required to maintain the temperature expressed in B.t.u. per hour for the average room and in per cent of that required for rooms midway between the top and bottom of the building, as observed in the 38-story Grant Building and as reported for the 47-story Penobscot Building, Detroit.

Comparison of the relationship between estimated heat requirement and heat supplied in order to maintain the desired temperatures shows that, when due consideration is given to the actual pressure drop through the window and the effect of solar radiation, the actual input always ranged within 12%, and usually a much smaller percentage, of the estimated requirement. The results of the study in the Grant Building and other similar studies are so varied as to indicate that results on more buildings must be obtained before a general formula for design purposes can be evaluated.

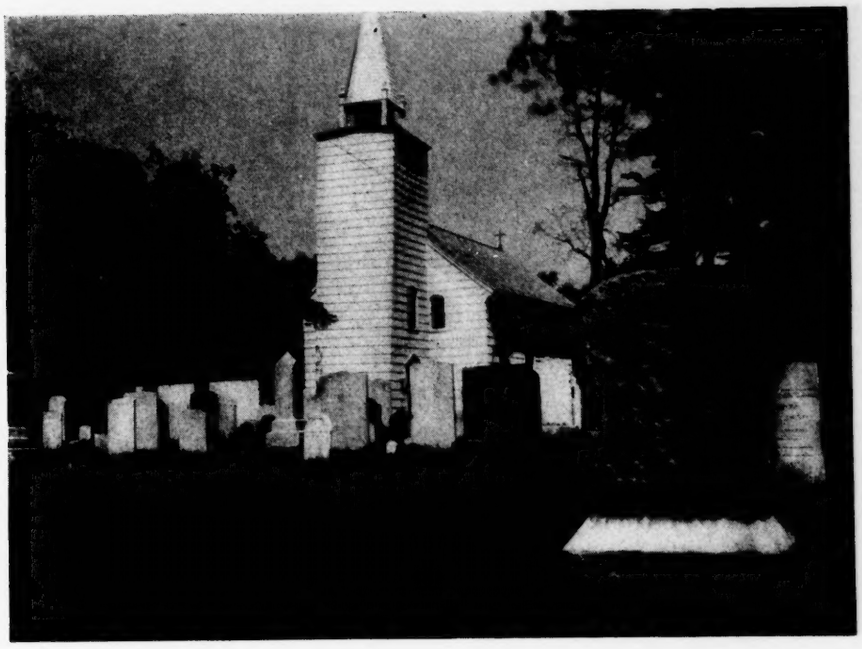
Air Conditioning Code

The Proposed Code of Minimum Requirements for Comfort Air Conditioning was presented for consideration by the members. This code is sponsored by a joint committee of the ASHVE and ASRE composed of the following: L. A. Harding, chairman; Glenn Muffly, vice-chairman; D. E. French, W. L. Fleisher, John Howatt, A. P. Kratz, L. A. Philipp, H. J. Macintire, C. W. Walton, Jr., W. E. Zieber.

The purpose of the code is to provide a uniform procedure and methods in connection with the design of comfort air conditioning systems. It consists of definitions, statements regarding design temperature and humidities, heating load estimates, cooling load estimates, air distribution, and apparatus rating.

Two opposing views of the code were discussed. In view of the wide variation in estimates for proposed air conditioned installations submitted by various engineers and contractors, a variation amounting to over 100% in numerous cases, it is felt by many that certain conditions should be stated in a minimum code so that all bidders on a project can bid on substantially the same conditions. On the other hand opponents of the code claim that by codifying these codes many of the fundamental design procedure methods would be "frozen" and perhaps difficult to modify or keep up to date when more complete information is available than is now the case. The status of this code now is that it is being held under consideration.

Split System Conditions 200-Year-Old Long Island Church



The installation of a modern air conditioning system in this two-hundred-year-old church has made possible the removal of an old radiator heating system and the restoration of the church to its original appearance. Concealed registers are used in order to change the interior as little as possible. The new system has one boiler which supplies two conditioning units, one convector and two radiators.

THE Caroline Episcopal Church at Setauket, L. I., N. Y., is the oldest church on Long Island, having been erected in 1729. Recently, the vestrymen of the church approved plans for air conditioning and restoring the church to its original Colonial style.

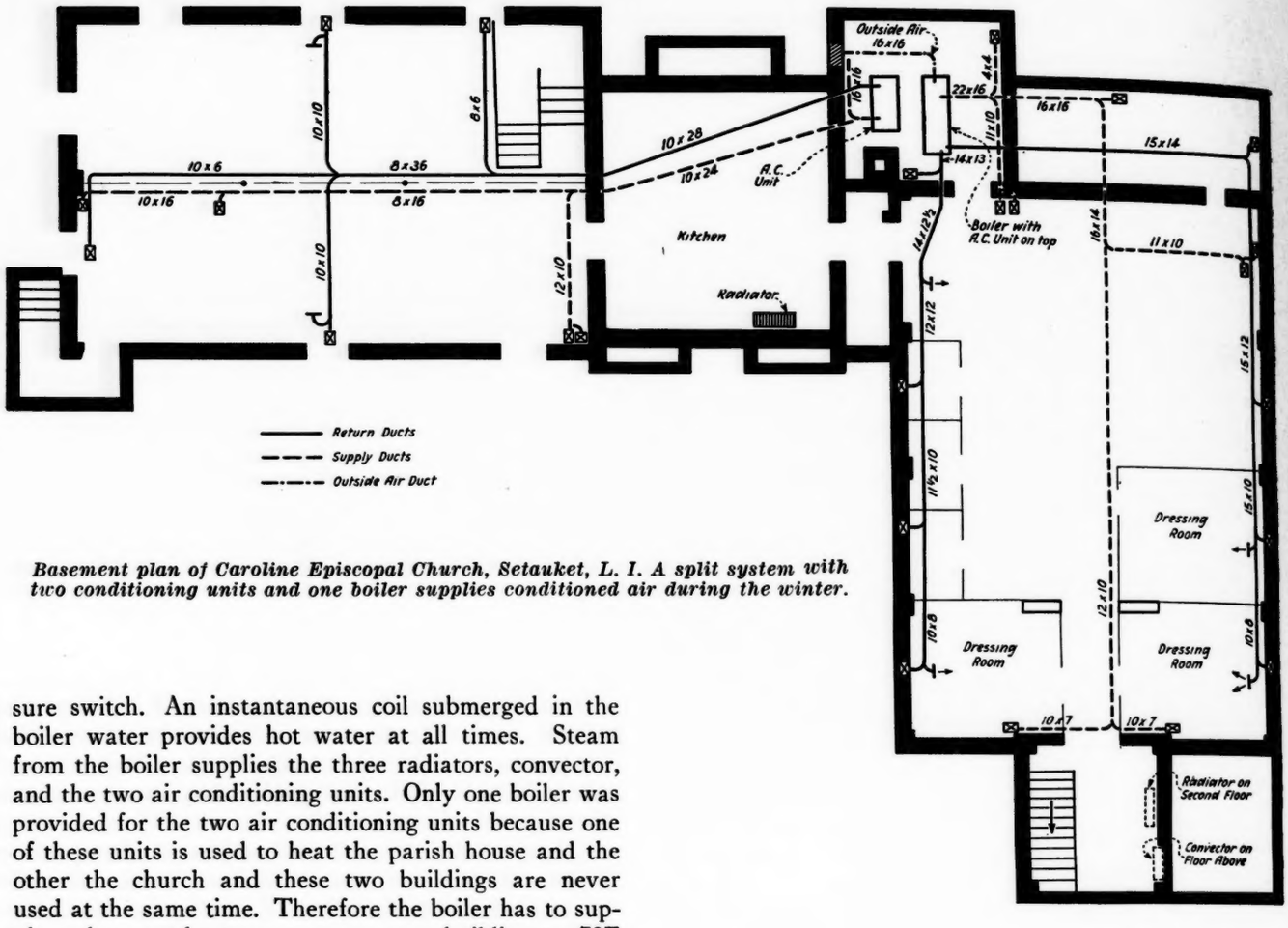
When built in 1729 the church had a simple Colonial design but in 1885 the interior was changed to conform to the Victorian style of the day. A frescoed ceiling was placed over the original Colonial barrel ceiling, the design of the pews changed, the original flagstone tile floor removed, and numerous other changes were made. All of these alterations have now been replaced by reproduction of the originals as far as it is possible to duplicate them. When the changes of the church were planned all the available records were canvassed for descriptions of the church as it existed in Colonial days.

Besides the changes made to restore the church to its original condition a number of modern improvements were also made. These included the construction of a full basement under the church and the parish house, the installation of a new concealed organ, and the installation of a complete winter air conditioning system.

The parish house which was formerly connected directly to the church was moved about 15 ft. away and is now connected only through the new basement and the roof which has been built over the passageway between the two buildings. The new basement excavated underneath the church and parish house has been divided into a number of rooms, including a meeting room, dressing room, kitchen and boiler room.

Up to the time that the changes were made the church had been heated by an antiquated one-pipe steam system which had a coal-fired boiler installed in a small boiler room underneath the church. The exposed old-fashioned radiators did much to spoil the appearance of the interior of the church. The new system does away with most of the radiators except a few in isolated spots. The new equipment is arranged in the form of a split system and is designed to completely winter air condition both the church and parish house.

It consists of a gas-fired steam heating boiler, two air conditioning units, one convector, three radiators, and the necessary controls, pipes, ducts and registers. The gas is burned in a steel horizontal tubular boiler which is equipped with a low water cut-off and pres-



Basement plan of Caroline Episcopal Church, Setauket, L. I. A split system with two conditioning units and one boiler supplies conditioned air during the winter.

sure switch. An instantaneous coil submerged in the boiler water provides hot water at all times. Steam from the boiler supplies the three radiators, convector, and the two air conditioning units. Only one boiler was provided for the two air conditioning units because one of these units is used to heat the parish house and the other the church and these two buildings are never used at the same time. Therefore the boiler has to supply only enough steam to warm one building to 70F and the other to a minimum temperature of 50F or 55F.

The air conditioning unit heating the church is located directly over the steam boiler while the other has been placed at the side of the boiler. The unit over the boiler is the larger one and supplies conditioned air to both the church and church basement. Two ducts, one 15 x 14 and the other 14 x 13, distribute the air throughout the church building. These ducts are located on the ceiling of the basement and are connected by risers built in the walls to the registers located in the window sills. These same ducts also supply air to the dressing room and meeting room in the basement by means of ceiling grilles. Air grilles located at the floor level in both the church and basement return the air which is to be recirculated by the air conditioning unit. Outside air is brought into the unit through a 16 x 16 in. duct.

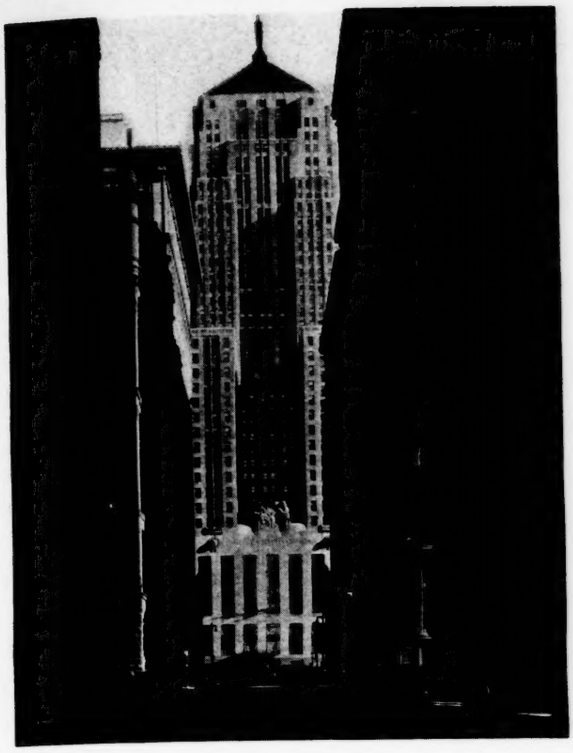
The second air conditioning unit supplies conditioned air to the parish house by means of a 28 x 10 in. duct which runs on the basement ceiling. Four supply grilles located at the floor level furnish air to the upper floor of the parish house. A single return grille located in the corner of the room at the floor level withdraws air from the room. Conditioned air is furnished to the basement by two grilles located in the ceiling. Two floor grilles pick up the return air from the basement.

As mentioned previously, heat is also supplied by three radiators and one convector. Two of these radiators are located in rooms where it would not be desirable to recirculate the air, the kitchen and the toilet. The third radiator is located in the second floor room in the belfry. A radiator was installed in this location because of the difficulty of running a duct to the second floor. The convector which has been installed in the entrance is of large capacity to warm the large amounts of cold air which enter.

The total heat loss of both buildings was calculated to be 177,000 B.t.u. per hr. divided into 110,100 B.t.u. for the church and 66,900 for the parish house. A modulated bypassing system is incorporated in the air conditioning unit to obtain a continuous warm air circulation without drafts. A modulating thermostat operates a damper motor which opens and closes a bypass damper to allow more or less of the recirculating air to bypass the heater in accordance with temperature changes in the room. As the room temperature rises more air is bypassed around the heater. The gas boiler is controlled by an auxiliary on the damper motor.

A thermostat and humidistat is provided in both the church and parish house. When the thermostat calls for heat it closes the bypass damper so that a larger portion of the air is heated. The humidistat is connected to a solenoid valve which regulates the amount of water flowing to humidifying equipment. The humidifier is of the pan type with an adjustable water depth to control the capacity. When a higher humidity is required more water is allowed to enter into the evaporator, thus increasing the amount of the evaporation.

The Carrier air conditioning equipment was installed by the Nassau Engineering Co., Glen Cove, Long Island, under the direction of George Munson.



Air Conditioning in the World's Largest Grain Market

By GEORGE R. BAILEY†

There are problems in operating the air conditioning system in a large open space like the trading room of the Chicago Board of Trade. Getting satisfactory results there takes constant supervision. Hence a story of some of the difficulties as related by an operating man in his own style and language.

SEVERAL weeks ago a group of maintenance engineers sat about a big table in Chicago. They were waiting for several of their colleagues, who were late. This may annoy but it never surprises the tardy one's fellow engineers. They realize only too well the multitude of reasons that may delay any member of their profession, such as broken water mains, elevators stuck between floors, fires in electric cut-out cabinets, and complaints about air conditioning. These particular maintenance engineers were of the breed that operates buildings, hotels, and large structures in general. As a rule they learn a good deal about most things if not all about some.

One of the men, who had been reading a technical article on ventilation, suddenly tossed the publication onto the table and leaned back in his chair.

"I wish to goodness," he remarked, "that I'd run across a nice simple exposition on air conditioning one of these days. I never have time to interpret graphs and mathematical formulas; that sort of stuff is for the air conditioning engineer—the designer. What I'd like is a plain little tale about some specific installation. Just a grammar school explanation of what they want to do, what they actually do and how they do it. Then I could picture what's being discussed and make comparisons with our own methods of operation."

The speaker sucked on his pipe for a minute or two and then cast his fishy eye on the writer.

"You fellows operate one of the big plants in town," he stated accusingly, "why don't you knock together such an article? It would do you some good and it might do somebody else some good."

From the above you may well infer that the ensuing paragraphs are to be studded with the simplest of terms but pray don't infer that operating the air conditioning plant to be discussed is in any way simple. Every large air conditioning installation has its bugs. The plant in the Board of Trade Building has its bugs and in addition it has as critics some five or six hundred traders who work much of the time at fever heat, think at a split second rate, and tell you what they think with utter frankness. Members with bald heads and who sit still, don't care for drafts and those who are jammed into the pits and shout against a hundred others want more air and plenty of it; the "low blood pressures" want heat and the "high blood pressures" don't; the member making money will be satisfied as long as the market holds his attention but the unlucky trader with time on his hands is quite likely to call for Pete Niemann and pour into his sympathetic, if despairing ear, numerous comments on the state of the inside weather. Quite naturally the member considers the temperature and humidity of the air controllable. If it's too warm he expects a valve to be turned which will reduce the heat immediately. If he only knew! The air in a big room like the Trading Hall has inertia. There are nearly a million cubic feet of air in this room at all times and this great air volume has the same inertia as a big ocean liner. It takes a lot of pushing before the Queen Mary can be gotten under way. Conversely, a volume of air as great as this has momentum. With the air getting warmer at a rate of two degrees per hour, for instance, just try to stop the increasing temperature instantly. It can't be done. There's already warmer air on the way that's shoved along by the cooler air you admit. The party who claims he is suffocating at 73F listens while you tell him that you have begun delivering air at 68F. The temperature rises half a degree! The party gives you a baleful glance and walks away. You told him you were shooting in colder air but the temperature just went up. What the hell!

†Supervising Engineer, Albert H. Wetten & Co., Chicago.

The duty of the air conditioning equipment in the Board of Trade Building is to properly ventilate and to maintain the desired temperature in the Trading Hall, the Smoking Room, the Visitors' Room, the basement restaurants and safe deposit vaults, and the executive offices. The schematic diagram reproduced here indicates the relative locations of these four points of use. The capacities of the supply fans serving these separate rooms are posted below. There is of course an adequate exhaust system.

Trading hall	C.f.m.—	56,950
Smoking room	"	15,000
Visitors' room	"	11,000
Restaurants and vaults	"	33,500
Executive offices	"	14,900

The following general statistics may convey a quick idea of what is involved in a summer's operation, covering the period extending from June 1 to September 1, although occasional refrigeration is supplied both before and after these dates:

Total volume of rooms, conditioned	1,604,160 cu. ft.
Total air supplied	131,350 c.f.m.
Total capacity of compressors	390 tons
Total water used in condensers	1,470,000 cu. ft.
Total CO_2 required per season	5,000 lb.
Total current to drive compressors	75,900 kw-hr.

The trading hall is given refrigeration from 8 a.m. until 2 p.m. on the average; the smoking room and visitors' room for the same hours; the restaurants from 10 a.m. until 2 p.m., and the executive offices from 9 a.m. until 4 p.m. Variations in outside temperatures and board activities make it impossible to quote exact ton-hours or c.f.m.—degree-days. The executive offices are not as intensively air conditioned as the four large rooms and have not been indicated on the sketch.

The system is simply illustrated by the diagram. Liquid carbon dioxide is compressed by the machines in the sub-basement and this liquid under pressure is pumped to the air washers. Each washer is equipped with a pan in which there is an expansion coil. The coils are covered with water. The liquid carbon dioxide is admitted to the coils through an expansion valve and upon vaporizing absorbs the heat from the water, thus lowering its temperature. The carbon dioxide, now in gas form, is drawn back to the condensers in the sub-basement where it again liquefies.

The cooled water in the pans of the air washers is forced through spray heads by circulating pumps and the incoming air is cooled by passing same through the water sprays. The air is also cleaned by passing it through oil filters consisting of louvers or trays on which there is a sticky oil to which particles of dirt and dust adhere. During cold weather this air is heated by three banks of radiators through which it must pass.

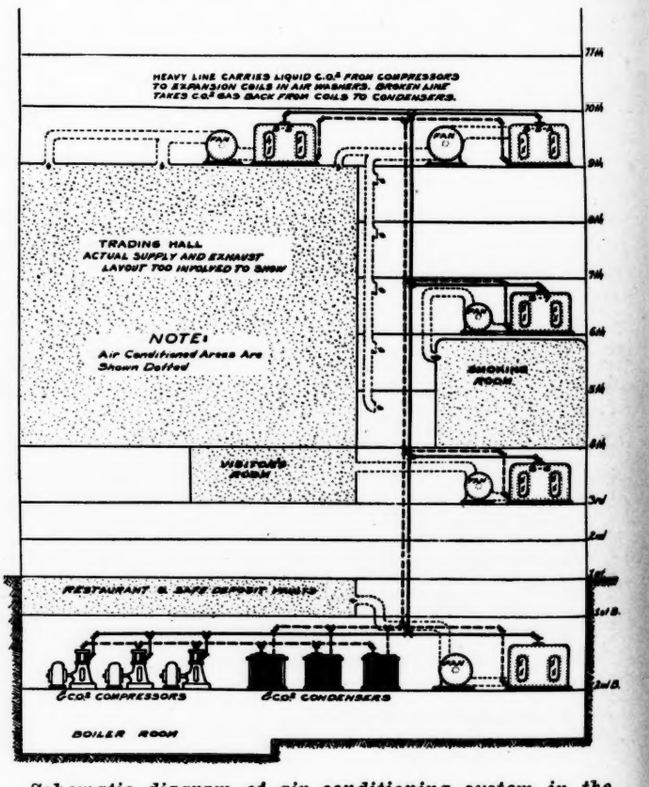
The temperature of the air is dependent on several factors—the speed of the fans, the temperature of the outside air, the control of expansion valve, after full capacity is reached the load on the system, the setting of the recirculation dampers, the setting of the condenser water valves, and the temperature of the city water. All these factors must be taken into consideration and watched.

William Mabbs, chief engineer of the Board of Trade Building, sees to it that the mechanical equipment is in good order and properly operated, and Peter Niemann of the Board of Trade itself watches the manual controls. Pete has lived with the system for seven years now and has developed the ability to sense changes almost before the instruments record them. We stated before that the large volume of air in the trading hall has momentum. Unless Pete is constantly alert, one of the many variables that affect temperatures changes, and before adjustments can be made the temperature will have swung eight or ten degrees.

Perhaps Pete has been called away for an hour. He returns to the floor and finds that the air is too warm. A trader in the wheat pit asks him for God's sake to shut off the heat. Pete knows that he cannot bring down the entire room temperature quickly enough to satisfy the Trader. He slows down the exhaust fan that is drawing air into the grilles in the bottom of the pit. The rush of warm air past the trader is reduced and he is satisfied until the room temperature is reduced to the point where the pit exhaust can again be stepped up. But Pete must be careful not to get the exhaust out of step with the supply, or drafts will be blowing in unexpected places. Insufficient exhaust in the winter, when there is a tremendous stack suction up the 45-story elevator shafts, would result in a perfect hurricane at the entrance doors to the main hall.

Suppose the trading hall is reported to be too cold. At first thought it would appear advisable to recirculate intensively until the temperature is raised to the desired point. Experiments have proved that the trading hall temperature can be raised quicker without recirculating. This is true because the volume of air that can be recirculated is limited by duct sizes to less than 50% of the fan capacity and a full volume of air at 80F will heat the trading hall quicker than a much lesser volume at 100F.

A condition that complicates the control of trading


HEAVY LINE CARRIES LIQUID CO_2 FROM COMPRESSORS TO EXPANSION COILS IN AIR WASHERS. BROKEN LINE TAKES CO_2 GAS BACK FROM COILS TO CONDENSERS.
TRADING HALL
ACTUAL SUPPLY AND EXHAUST LAYOUT TOO INVOLVED TO SHOW
NOTE:
Air Conditioned Areas Are Shown Dotted
SMOKING ROOM
VISITORS' ROOM
RESTAURANT & SAFE DEPOSIT VAULTS
CO_2 COMPRESSORS
CO_2 CONDENSERS
BOILER ROOM

Schematic diagram of air conditioning system in the Board of Trade Building. Only supply system is shown.

room temperatures is represented by the north windows. There are no windows on the east, west or south but the north wall is filled with nine huge windows 12 ft. wide and 50 ft. high. This tremendous glass area becomes a real menace to comfort when a strong north wind blows down La Salle Street against them with outside temperatures reading zero or colder. Each window has direct radiation concealed below the stool and warm air is introduced on either side of each window opening from ducts which terminate 12 ft. above the floor. These ducts are on a system provided with booster coils which permit the air temperatures to be raised to a high level. Unless the boosters are used, the curtain of cold air that drops down the face of the glass actually overcomes the warm air from the direct radiation and we find cold air dropping through the grilles onto the concealed radiators under the window stools. These large windows are glazed with single lights of glass. Double glass would have created awkward problems in connection with frequent cleaning.

Another 'bug' that had to be overcome appeared when a special valve was installed on the heating riser through which all steam reaches the building from the boilers. This valve was installed as a means of economizing on steam and it operated successfully but its basic principle was to limit the supply of steam to that amount actually required from minute to minute by condensation. Once the valve had been calibrated or set to provide proper temperatures it proceeded to do just what the manufacturers had claimed it would do —it locked the system. When Pete attempted to increase temperatures quickly it was discovered that with the new valve in operation it could not be done. The valve would not permit overheating. The condition was rectified by piping high pressure steam through a pressure reducing valve direct to the ventos in the trading hall air washers. During cold weather this high pressure line is used but during spring and fall weather the steam can be taken through the new valve.

Although it is possible to increase temperature more quickly during moderately cold weather by not recirculating, it is necessary once or twice a year during extremely cold weather to recirculate to hold a comfortable temperature but some fresh air is always admitted even then. The same is true with the refrigeration during the summer.

Trading floor in Chicago Board of Trade Building. Wheat pit in foreground.

The air delivered to the trading hall and the executive offices is taken in at the bottom of the north court of the building at the 10th floor level. The air first passes over the tempering coils for its first heating. It next goes through the oil filters to be cleaned and then passes in order through the priming coils, the water spray, the finishing coils, and the fan. The water spray is operated during the winter to increase the humidity somewhat and to lend a certain freshness to the air.

In connection with the smoking room we were puzzled for some time by the stale odor that seemed to come even with 100% fresh air when the system was started in the morning. We soon discovered that the water used in the sprays had to be changed regularly each day whenever any recirculation was employed as the water absorbed the odor of cigar smoke and imparted it to fresh air when the recirculation was stopped.

During the summer refrigeration presents as many difficulties as does heating during severe winter weather. Originally some of the cooled air was introduced through grilles in the face of the markers' balcony about twelve feet above the trading hall floor. The cooled air would first drop on the necks of the telephone men who remain seated along the sides of the Hall and would then move to the pits. The air could not be cooled much without disturbing these telephone traders and it was warmed some by passing over them with the result that it was far too warm for the Traders in the pits who are on their feet and forced to shout and signal trades. This air is now sent into the room from uptilted louvers which intercept the supply ducts near the ceiling and the cooled air loops over the telephone desks into the pits. Other sources of supply and natural distribution provide plenty of conditioned air for the telephone sections without any direct draft although Pete is still accused of manufacturing drafts from time to time—a difficult thing to avoid where better than seventy thousand cubic feet of air is introduced into and exhausted from a room during each minute.

Pete has found that in general a winter temperature of 70F to 72F is most satisfactory and he attempts during the summer to keep the trading hall 15F below the outside temperature. Quite naturally a big change in the humidity will immediately be felt by the traders and as they associate a satisfactory condition with a certain temperature, there are times when we wish we might throw out the thermometers in the trading hall.

As we mentioned above, the key to successful air conditioning in the Board of Trade is constant alertness. Automatic devices will not suffice and those that we have on auxiliary equipment will fail from time to time, requiring an instant inspection of a system distributed over 11 stories. If the city water increases in temperature the condenser valves must be adjusted; if the outside air changes the expansion valves must be adjusted; if the restaurant load is suddenly thrown on at 10 a.m. the hump that would normally occur during capacity weather must be compensated for, and in addition there are humidity and drafts and personal preferences to be combated. Not so mysterious or intricate all this—but darned exacting!

Temperature Distribution in Two Greenhouses

R. H. SOGARD†

THE most recent greenhouse added at the University of Missouri is a 35 ft. x 125 ft. isolated unit. To learn the possibilities of more uniform temperature distribution in this house, convection heaters were installed instead of the customary radiant heating equipment. Convection units installed are non-ferrous, each 96 in. long, there being 24 of them in the house.

To determine temperature distribution in this house and to compare it with the temperatures in a radiant heated greenhouse, readings were taken at 25 points proportionately located in the convection house and in a 25 ft. x 100 ft. house heated with radiant coils. The readings were taken at night, to eliminate sun effect and the outside temperature and wind conditions were the same for all readings.

The temperature models illustrated were constructed from the five transverse temperature sections taken in each house. The beveled top of the base of each represents the greenhouse floor plan to scale. The base itself represents 60F temperature and temperatures above 60F are as indicated by the scales on the first transverse section. The maximum variation across any one section in the convection house was 2.4F; the maximum variation across the radiant house in any one section was 11.0F. The maximum difference in the radiant house is 14.6F. For general evenness of temperature distribution, the models show clearly the variations.

There is no automatic control in either house. Readings were taken with all heating surface in service in both houses. The view in each picture is from the north end of the house, there being a south wind blowing against the opposite end. This accounts for the larger temperature variation at the far end of the radiant house.

No measurement was made of steam consumption for either house, as the convection house is a two-pipe vacuum system, while the radiant house is a two-pipe pressure system. Because of this difference, the radiant house would be unfairly penalized.

The convection-heated house has gone through its first winter and apparently gives promise of being permanently satisfactory. The stacks for the convectors were made of 22-gage galvanized iron, fully open at the bottom and top, with a ½-in. mesh screen across the top.

†Superintendent of Buildings and Grounds, University of Missouri.

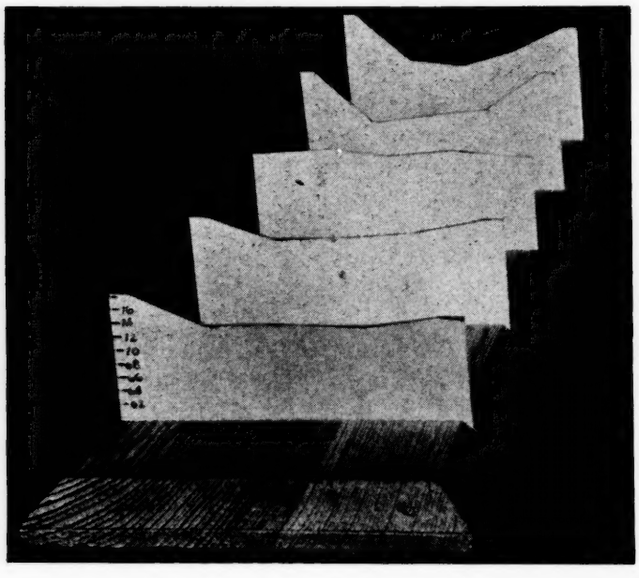
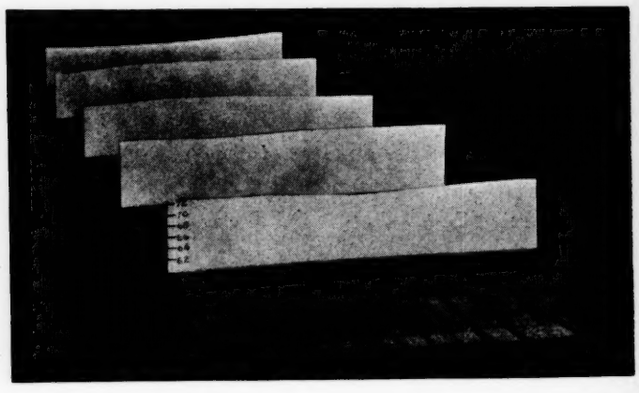


Fig. 1. (Left) Temperatures across 25 ft. x 100 ft. greenhouse heated with radiant coils. Fig. 2, (Below) Temperatures across 35 ft. x 125 ft. greenhouse heated with convection heaters.



Heat to Disperse Fog at English Airports

THE prospect of applying heat to the dispersal of fog over airports and to assist in the propulsion of high-speed airplanes is mentioned in the report of the British Aeronautical Research Committee, recently published. The growth of air traffic has made the question of fog dispersal, costly though it is likely to be, worthy of further investigation. The demand of the operators is for a system which will keep a space 250 yds. long, 100 ft. wide, and 300 ft. deep clear for a period of 5 min. The committee believes that the process is not impracticable and as a result experimental heating plants for fog and mist dispersal purposes may be installed at various British airports in the near future.

Steam Traps and Their Characteristics

2.—Float and Bucket Traps

By T. NAPIER ADLAM†

Continuing his description of the operating principles of some of the types of steam traps in common use, the author here covers float and bucket traps. Succeeding installments of this series will be devoted to other types of traps and to methods of estimating the amount of condensate to be handled.

A TYPICAL example of a float and thermostatic trap for low and medium pressures is illustrated in Fig. 5.

The principal characteristic of a float-thermostatic trap is that it discharges the condensate at practically the same temperature as that of the steam except for a slight cooling effect which takes place within the trap body. The rate of discharge from these traps is very consistent, depending almost entirely on the rate at which the condensate reaches the trap. In other words, it is not a trap with an intermittent action.

As water enters the inlet, A, and collects in the body of the trap, it raises the float, F, which in turn opens the discharge valve, V, and allows the condensate to pass out at a rate depending upon the distance which the valve head, H, moves away from the seat. As the distance moved by the valve head depends upon the upward movement of the float, the discharge is maintained at practically the same rate as it enters the trap; provided, of course, that the trap has sufficient capacity to deal with all loads placed upon it.

As soon as the condensate ceases to enter the trap, the water level and the float fall, and eventually reach a level where the float drops sufficiently to close the valve entirely, when no further water can leave the trap. As the discharge valve is always submerged, no steam can reach it, and since the lower stratum of water which surrounds the valve and seat is invariably somewhat cooler than the steam, it protects the valve and seat from erosive action of the steam.

The valve mechanism is so constructed that it is possible, after removing the body, to lift the float sufficiently high to allow the valve head, H, to be removed with the fingers so that it can be cleaned, ground in, or replaced with a new one in the course of a few seconds.

The thermostatic air vent, E, which is placed as high as possible in the trap body, operates as does a similar element used in thermostatic traps.

When cold, the bellows of this element is contracted so that the air valve, B, remains fully open, thereby allowing all air and other incondensable gases to pass freely through the trap to the outlet. As soon as the steam enters the trap body and surrounds the element, E, it causes the element to expand and close the air valve, leaving the float to operate the valve, V, and take care of all condensate entering the trap. When air is carried along with the steam, as is invariably the case, especially when makeup feed water is used in the boiler, it will, on entering the trap, slightly reduce the temperature in the upper part of the trap surrounding the element, E, thereby causing it to contract and open the air valve sufficiently to allow the air to escape, thus enabling the water to enter the trap freely so the float can function according to the amount of condensate collecting.

It is easy to see how important it is to have a thermostatic element in these traps that operates at temperatures fairly close to that of the steam. If the element should operate at a temperature much lower than the steam, then air will be allowed to collect inside the trap and may seriously retard the flow of water, gradually holding up the condensate and reducing the output of the trap considerably. Often a trap may be blamed as being too small when the whole trouble is due to a sluggish air vent element.

Capacity

The capacity of this type of trap cannot be judged by the size of its body, neither can it be judged entirely by the area of the seat orifice. The operating power of this trap depends upon the buoyancy of the float and the mechanical advantage of the lever mechanism; while the size of the seat orifice, the shape of the valve head, and the movement obtained are factors controlling its capacity. The power to open the discharge valve, V, against the internal pressure can be better

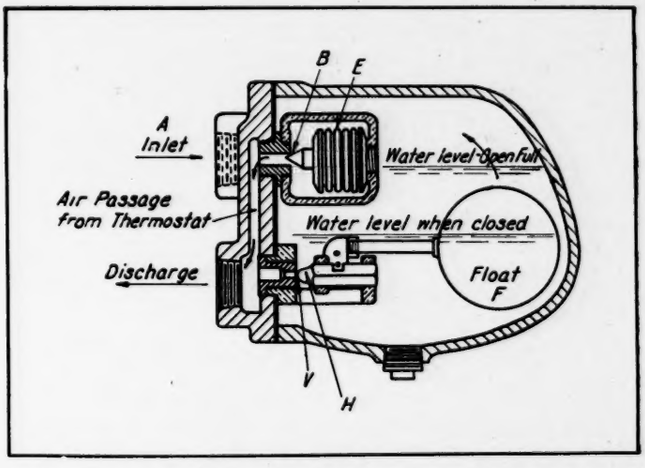
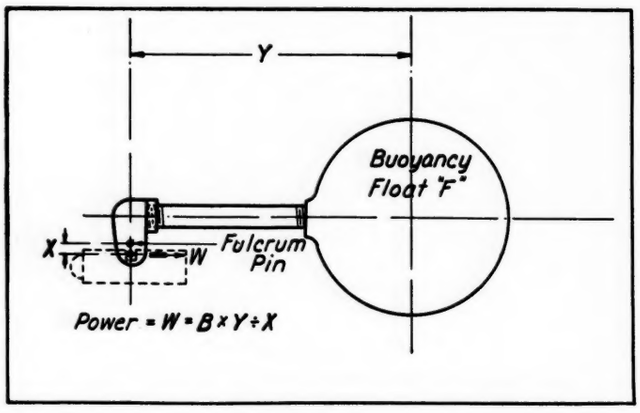
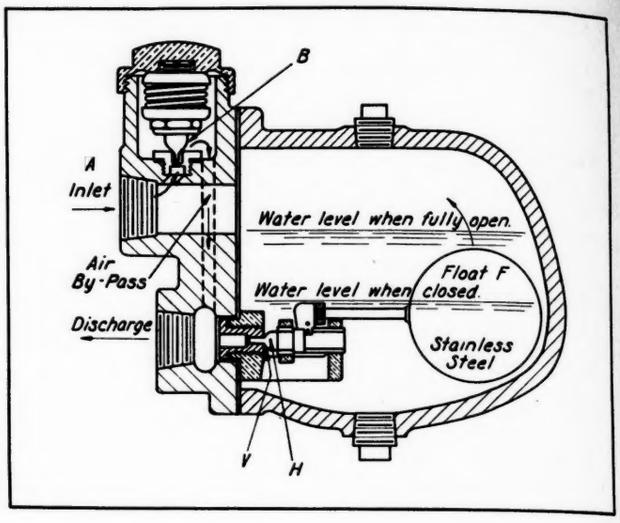


Fig. 5. Section through low-pressure float and thermostatic trap.

†Chief Engineer, Sarco Co., Inc.

Fig. 6. (Below) Float mechanism in float trap. Fig. 7. (Right) High-pressure float and thermostatic trap.





understood by reference to Fig. 6, where the buoyancy of the float is represented by B.

The power W to lift the valve from the seat is represented by $B \times Y \div X$. Since the mechanical advantage of the lever mechanism is Y/X, then any decrease in the dimension X in the foregoing equation will increase the mechanical advantage correspondingly, so that by making the distance X short it is possible to obtain greater power and a consequent larger seat area with a relatively short arm Y. The advantage of the particular mechanism as illustrated in Fig. 6 is due to the fact that X, being made very short, allows great leverage, so that considerable power and large capacity are obtained with a compact mechanism which can be housed in a small trap body. This proves that a long float arm with a large trap body is not in itself any criterion as to the capacity of a float trap.

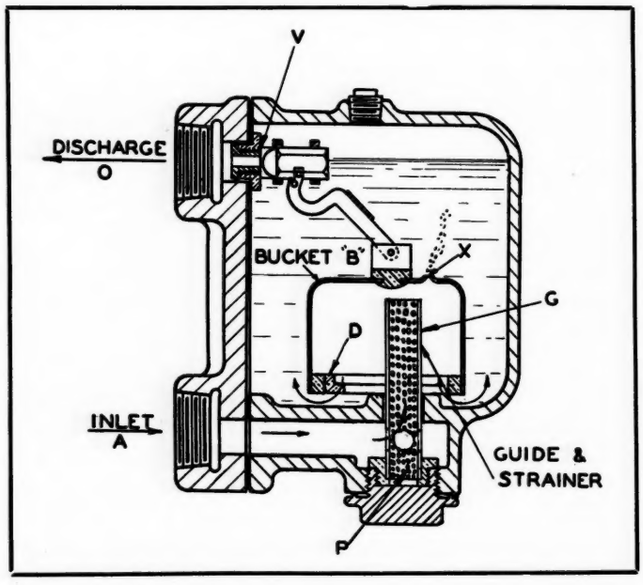
Because of the very large and steady discharge obtainable with a well designed float-thermostatic trap with the free gravity flow of water through the trap even without the aid of steam pressure, the float-thermostatic trap is, undoubtedly, the best and most suitable trap for all low pressure heating mains and heating units. It is also one of the most suitable and reliable traps for low and medium pressure industrial work where the water has to be carried away at high temperatures and where delicate temperature control is necessary.

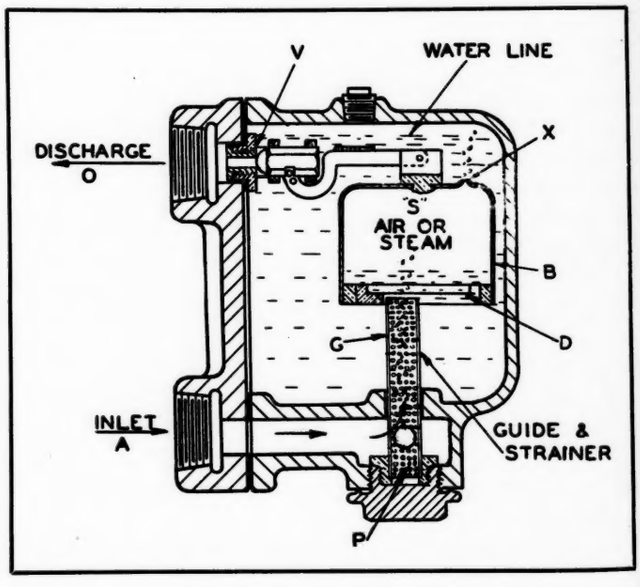
Traps for Industrial Work

Where float-thermostatic traps are used in connection with high pressure steam, it is advisable to have stainless steel or monel metal floats since these can now be constructed to withstand high pressures and temperatures. Since the power available to operate the valve depends upon the buoyancy of the float it is advisable to choose a float having the greatest lifting power for its size and strength. It is, however, largely due to the fact that for high steam pressure a strong and expensive float has to be used that inverted bucket traps, which are cheaper to make, become more enticing at the higher pressures.

A typical high pressure float trap is illustrated in Fig. 7, where it will be noticed that the thermostatic air relief is housed in a separate chamber.

The thermostatic element used on high pressure float





Figs. 8 (Left) and 9 (Right). Inverted bucket trap with valve to discharge line open (8) and closed (9).

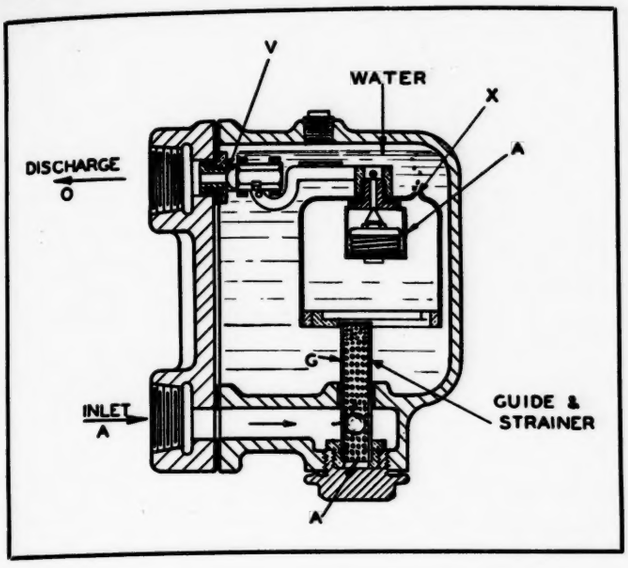
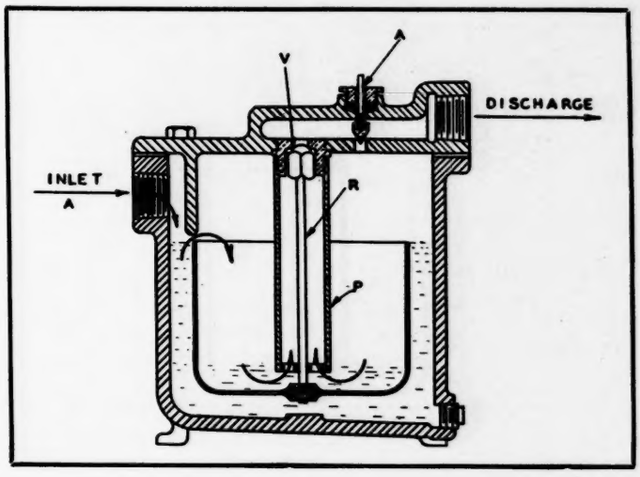


Fig. 10. (Left) Inverted bucket trap with thermostatic element. Fig. 11 (Below) Open top bucket trap with vertical moving bucket.



traps should be constructed to withstand the extra strain and stresses associated with high pressure steam. It makes little difference whether the steam pressure is acting on the outside of the element or whether the element is situated to have the inlet under the valve head. If it is placed so that the steam pressure surrounds the element, then the pressures will be balanced while working, but every time the steam is shut off there will be a full, unbalanced pressure; whereas, if the inlet is under the valve head and no pressure exists surrounding the bellows, then as the metal of the trap heats up to steam temperature there will be a very great unbalanced pressure on the element at all times. In either case, an ordinary thermostatic element is entirely unsuitable for these high pressure traps.

Inverted Bucket Traps

There are many different types of inverted bucket traps on the market working on the same principle, a typical illustration being shown in Fig. 8.

An inverted bucket trap is very suitable for high steam pressures, also where corrosive agents exist in the condensate because it can be readily constructed with special metals to withstand corrosion and high steam temperatures.

Referring to the illustration Fig. 8, the bucket, B, is constructed with a small hole, X, at the top to allow air and other incondensable gases to escape, otherwise the bucket could not drop to open the valve, V.

Steam, water, and air enter through the inlet, A, and are discharged upwards into the inverted bucket. As long as only water enters the trap, the bucket, by virtue of its own weight, rests at the bottom of the trap body, allowing the valve, V, to remain fully open as shown in Fig. 8.

Under these conditions the condensate can pass freely through the trap to the discharge outlet, O, being pushed forward and upward by the steam pressure in the pipe leading to the trap.

When air in large volume enters the bucket, B, with the water and cannot pass freely through the hole, X, it will collect in the top of the bucket and replace some of the water. If sufficient air accumulates in the bucket to displace most of the water, it will make the bucket buoyant, causing it to rise and thereby closing the valve, V, as shown in Fig. 9.

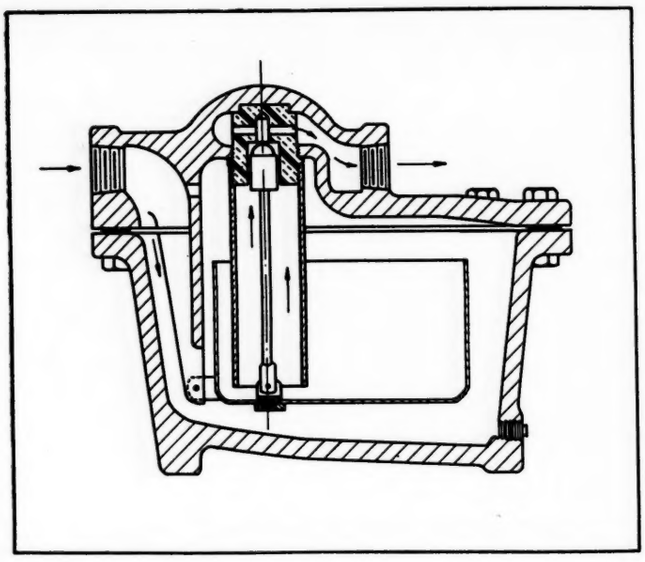
The closing of the valve, V, prevents further discharge from the trap and it remains closed until the air in the top of the bucket can escape through the hole, X, thereby allowing the bucket to drop again and open the valve. This cycle of operations will continue until all air has been expelled from the apparatus or system to which the trap is attached.

When steam enters the trap with the water it rises into the bucket and displaces some of the water, causing the bucket to become buoyant in the same manner described for air, but when steam enters the bucket it will quickly condense and give up its heat to the surrounding water until all the water in the trap reaches the full temperature of the steam, after which it will hold the bucket in a buoyant condition for longer periods.

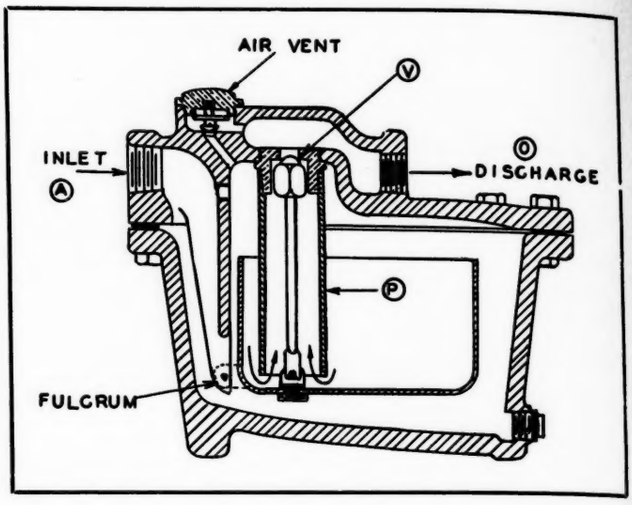
Under ordinary conditions of operation some of the steam which collects in the bucket will condense as heat is lost by direct contact with the bucket and water, due to the gradual cooling of the trap, but most of this steam escapes through the small hole, X, at the top of the bucket into the space at the top of the trap. The steam which escapes into the top of the trap, if not condensed, will be discharged with the water when the trap opens, so it is important not to have the hole in the top of the bucket too large.

As the steam leaves the bucket, either by condensing or by passing through the small hole, X, water enters at the bottom and allows the bucket to drop, thereby opening the valve, V, again. This enables the trap to discharge water and at the same time more condensate and steam enter the trap from the inlet pipe. Water alone entering the trap will be discharged continuously until sufficient steam has entered to again partly fill the bucket and make it buoyant.

Fig. 10 illustrates the bucket of a trap fitted with a thermostatic element to automatically liberate air and other incondensable gases from the top of the bucket.



Figs. 12 (Left) and 13 (Below). Hinged bucket traps without air vent (12) and with air vent (13).



Vertical Open Top Bucket Traps

This type of trap functions by the direct vertical movement of an open top bucket which opens and closes the valve, V, as it falls and rises alternately.

When the condensate entering the trap at A in Fig. 11 fills the bucket, it causes it to drop because of its weight; while during the discharge operation, when water is discharged from the bucket up the pipe, P, the bucket becomes buoyant again and rises.

The area of the valve, V, is governed by the direct weight of the bucket as there is no lever mechanism to obtain a mechanical advantage or to increase power.

Sometimes these traps are also designed to give the bucket a free vertical movement so that it falls a given distance before it engages the rod, R, of the discharge valve, V. In this way it utilizes its momentum to help jerk the valve from its seat against the internal pressure.

Figs. 12 and 13 illustrate another type of open top bucket trap where the bucket is hinged internally. Fig. 12 illustrates the trap without an air vent, which would be unsatisfactory unless an outside air vent were installed to carry away the air; while Fig. 13 illustrates an automatically air vented trap.

Next month's article in this series will be devoted to expansion, orifice, impulse, and siphon traps.

Ventilation to Protect Chapel Against Insects

FEARS that wood-devouring beetles threatened the roof timbers of old King's Chapel, Boston, Mass., one of America's historic shrines, has prompted the trustees and vestrymen to have the entire roof examined and overhauled. Should the pests get a big start, the entire heavy roof, of slate and copper, might crash, greatly damaging the beautiful interior.

About a year ago the presence of this unique wood beetle, known as Hylotrupes Bajulus L, was discovered in certain timbers of the chapel roof, and it was decided to take steps to remove them, as well as to make such changes as would prevent their return.

The work of correction and control will include a system of ventilation designed to lower the air temperature above the ceiling and around the roof at all seasons of the year and to create active air currents. The chapel is heated by steam, and the temperature up around the roof, with its heavy covering of slate and copper, is conducive to the spread of this insect.

In Denmark this insect, because of its great activity in old buildings, has been the object of intensive study by scientists. It has appeared in only a few scattered places in England, but late reports from American entomologists reveal that it has been discovered in many sections of the United States, and usually under conditions where dry heat encourages their growth.

Research and experience show that the activity of these wood-eating insects is encouraged by conditions that result from dry heat in buildings covered with heat absorbing materials, such as slate, copper, and certain compositions. In such roof spaces as occur over the nave of King's Chapel, with its copper roof above and its heated interior below, conditions are ideal for the spread of such beetle life.

The corrective part of the work will include removal by vacuum of all infested wood, which, under the suction, breaks up just like so much "punk," and treatment of all surfaces of the wooden construction with highly toxic liquids. The next stage is the application of a more permanent liquid which will protect the wood against re-infestation for years, and the construction of ventilators to permit free circulation of air and lowering of the temperature under the roof, with the introduction of such moisture as the free air contains. This air circulation alone would deprive the insects of the dry conditions necessary to their existence, but the preservatives prevent the possibility of their effecting entrance again. The final phase of the work will be periodic examinations of all wood surfaces.

The work is in charge of Smith & Walker, Boston architects, with Donald Muirhead, acting as consultant and working with the architects, supervising the work.

Factors in the Selection of an Oil Burner

By ARTHUR H. SENNER†

This article is abstracted from a recent publication of the Bureau of Agricultural Engineering, U.S. Department of Agriculture, which conducted a large number of tests in order to obtain information for prospective buyers of oil burner equipment. This publication, Circular No. 406 of the Department of Agriculture, has had a wide distribution and this abstract from it is presented in the belief that readers will find it desirable to be acquainted with the contents of the circular.

SATISFACTORY results from the burning of oil fuel are dependent on several factors. In the first place, whether oil or some other fuel is used, the entire heating plant must be designed and laid out according to accepted principles of heating. This means that for satisfactory service the circulating system for the hot water, steam, or warm air must be properly proportioned and installed, and that the boiler or furnace must be of suitable size for the load imposed on it. If a boiler or furnace of inadequate capacity is used, the results will be overloading and a loss in overall efficiency. This is particularly true in the case of oil burning, in which the losses of heat up the chimney may be very large if both parts of the heating system are not adapted to each other.

Capacity

It is, of course, essential that the oil burner selected be of sufficient capacity to provide for the maximum heating demand. The practice of manufacturers in supplying heating capacities varies considerably. Some make a series of burners that are of similar construction but of different sizes and oil-burning capacities; others make two or three types of burners, each of which can be so adjusted as to fit a range of heating demands; still others make but one burner and depend upon adjustments to accommodate the various heating requirements. At least 1/5 gal. of oil per hr. will be required for each 100 sq. ft. of hot water radiation, and about 1/3 gal. of oil per hr. for each 100 sq. ft. of steam radiation, during the severest winter weather. This does not provide for domestic water heating. The manufacturer of the water heating equipment or an authorized agent should be consulted to determine this requirement. These figures are approximate peak demands, to be used only for determining the size of burner mechanism which should be supplied. It is not to be expected that the burner will operate at this rate during the entire season, therefore these figures cannot be used for computing the seasonal fuel consumption.

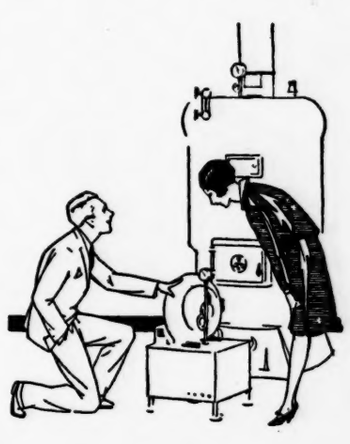
One of the most common questions asked by a prospective purchaser is "Which is the best type of oil burner, the gun burner or the vertical rotary or the pot type or some other type?" There is no single direct answer to this question. Each type of burner probably has a different efficiency in any given boiler. Therefore the burner efficiency can be properly considered only in connection with the boiler in which it is to be used.

Some types of boilers and burners naturally operate together better than do other combinations. For example, vertical rotary burners do best in round boilers, or those in which the length is not more than 75 or 100% greater than the width. They generally do not operate well in rectangular boilers of rather elongated firebox dimensions.

The pot or gun type burner can almost always be used in either round, square, or elongated types of firepots. On the other hand, the vertical rotary or pot type burners are more efficient than the gun burner in the many boilers which are deficient in flue travel[1] and in boilers which are overloaded. Many manufacturers realize that the gun type burner requires additional flue travel in the heater, or the equivalent in some sort of economizing device, and are recommending either the addition of sections to an existing boiler which may have inadequate heating surface or the installation of an economizing unit such as will be described subsequently. Such steps may bring up the efficiency of the installation to a sufficiently high value. With special oil burning boilers, complete boiler-burner units, or coal burning boilers with large amounts of heat-absorbing surface, substantially equal efficiencies can easily be attained for each of the several types of burners.

It is frequently asked, which of the several types of burners will be the ultimate types, which are becoming obsolete, and which are gaining in relative usage and importance? With the present supply of relatively light fuels, which will probably exist for some years to come, we should find examples of all of the present important types of burners on the market for an indefinite period.

However, more and more manufac-



†Associate Mechanical Engineer, Division of Structures, Bureau of Agricultural Engineering.

[1]The burning gases of the oil flame of a gun burner do not transmit heat to the firebox as effectively as does a burning mass of solid fuel; therefore a heater of minimum size for satisfactory service when burning coal is likely to be deficient in heat-absorbing surface when used with a gun type oil burner.

turers are going to the gun burner because of its simplicity, ease of design and manufacture, and relative freedom from patent complications. Not only is the gun burner simple to build, but it is also easy to install and service. This may be said also of those pot type burners that do not require a specially built combustion chamber as do most other types.

Removability

Some buyers insist upon a burner that can readily be removed to allow replacement of the grates in order to return to coal burning if the oil burner should fail or if electric current becomes unavailable for some time. Especially in isolated places, there may be loss of electric power for days at a time during severe storms; or the roads may be impassable so that the service man is not available for a considerable time. Under such circumstances an owner should insist upon a burner that can be pulled out by inexperienced labor in order that he may return temporarily to the use of coal.

Amount of Noise

A burner that is noisy is highly objectionable. The purchaser may insist on a noise clause in his contract so that, if the noise proves unbearable after a reasonable trial, the contractor shall remove the burner and relieve the purchaser of all obligations. All burners create some noise, but with most of the modern types, it does not prove enough to be objectionable under average house conditions. There are some exceptions to this rule, however, hence the noise clause.

Availability of Electricity and Gas

Most domestic oil burners of today require electricity or both gas and electricity. If both these facilities are not available, the choice of burners is restricted.

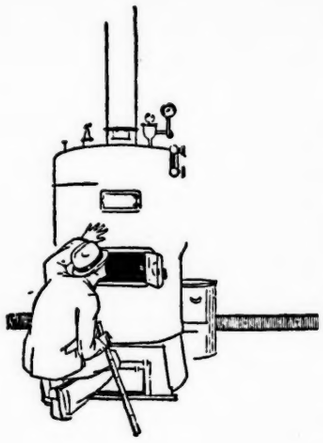
Service Requirements

It is generally agreed that the vertical rotary wall-wiping blue-flame burner of most designs requires more servicing than do other types of burners. This does not mean that they are a constant source of trouble, but that for one reason or another they have required more service calls than other types, for example, the gun type. This difference in service requirements however may actually mean very little to the user inasmuch as the service charges are frequently included in the price of the fuel oil.

Reliability of Local Representative

In selecting a burner it is well to keep in mind experience of other purchasers, and to seek not the best burner but rather one that is handled by a reliable organization which employs capable men to service their product. It is generally safe to conclude that such an organization will handle at least a reasonably good burner.

A first-grade burner improperly installed, or without opportunity of procuring service, will be unsatisfactory. All burners require some servicing. A burner that is



installed by inexperienced workmen, even with the aid of explicit printed instructions, is very likely to prove unsatisfactory in operation.

Selection of New Equipment

For many years there has been considerable discussion as to the relative merits of steel and of cast iron for domestic heating boilers. Use of steel boilers has increased rather markedly with the advent of the special oil burning type of boiler which has become more popular in recent years. However, cast iron is still much used for special oil burning boilers. This Department has not been able thus far to find any definite evidence as to the relative length of service that can be expected from the two types. There should be no inherent difference in efficiency between steel and cast iron boilers, but because some of the cast iron boilers are made in sections there is opportunity for skimping the number of sections, which sometimes has been done, resulting in low efficiency.

However, with intelligent design and proper selection of size of unit, including the right number of sections in the cast iron type, equal efficiencies can be obtained with both types of boilers.

Special Boilers for Oil Burning

Many new boilers designed primarily for oil or gas firing, made both of steel and of cast iron, have appeared on the market during the past several years. Most of these have been well engineered and show good operating characteristics, and good appearance through use of attractive jackets. They frequently have coils for domestic water heating built into them, and some even store the domestic water supply within the boiler thereby making it unnecessary to have a separate storage tank. Some provide means for garbage and trash disposal. These units cannot be used for burning coal because they lack provision for grates. If one is certain that he will not wish to return to the burning of solid fuel, it is well to consider the use of a special oil burning boiler when making a new installation, otherwise it will be safest to select a coal burning type with sufficient flue travel for satisfactory burning of oil. When the type of burner to be used is known, it is well to consult the boiler manufacturer as to the type best suited for operation with the particular burner selected as well as to the size of boiler.

Boiler-Burner Units

It is only a short step from the special boiler for oil burning to the so-called boiler-burner unit. The boiler-burner unit consists of a special oil burning boiler, of either steel or cast iron, fitted with an oil burner. The units are designed to provide maximum efficiency for the particular burners that are used with them. A coil

for domestic water heating is generally built into the unit. Such of these units as the Department of Agriculture has had the opportunity to test have been very efficient. Generally, the efficiency of the boiler-burner unit should be sufficiently higher than that of the average coal burning boiler when used for oil burning to obtain a fuel saving of from 15 to 20%. At the same time, the boiler-burner units are almost invariably designed to provide year-round domestic hot water, and this mode of generating hot water sometimes results in additional savings.

The first cost of the boiler-burner unit may seem relatively high, but actually may not be so for all the items involved. In the case of a new installation comprising a boiler, burner, and hot water generating equipment, probably the complete boiler-burner unit will cost no more; and any small difference in first cost will generally be offset by the higher average efficiency of the boiler-burner unit. If, however, an efficient type of coal burning boiler is already installed, together with satisfactory equipment for the generation of domestic hot water, it will be more difficult to justify the replacement of such equipment by a complete boiler-burner unit. In such instances it probably would be economical to add a well-designed oil burner to the existing plant provided the boiler is in good condition and of a type suited to the use of oil fuel. Many householders prefer the special oil burning boilers and boiler-burner units because they are of better appearance than some of the coal burning boilers equipped with oil burners.

Year-Round Hookup for Domestic Hot Water

Means have been devised to broaden the scope of usefulness of the domestic oil burner by having it provide domestic hot water throughout the entire year.

With the advent of oil heat and the transition from the continuous coal fire to what is generally an intermittent oil fire, many complaints were made relative to the lack of sufficient hot water. To overcome this condition, several types of indirect water heaters were developed. They consist generally of a cast iron jacket, connected by suitable pipes to the boiler in such manner as to form a circulating loop. Inside the jacket of the indirect heater is a coil, generally of copper tubing. This coil is connected to the domestic hot water storage tank. In more recent designs the coils are built directly within the boiler, but are removable, and in some types no auxiliary storage tank is necessary. With such a hookup it is impossible to overheat the domestic water supply to any serious degree. It should be borne in mind that connecting the domestic hot water pipes with the heating boiler increases its load as well as that on the burner.

The year-round hot water hookup can be applied to either steam, vapor, or hot water heating plants. It cannot be applied, however, to the warm air plants thus far marketed. With this type of hookup the burner operates the year round, and when the heating load is removed during the warm months the instruments controlling the temperature of the stored water assume the master control of the oil burner. It is not necessary for the householder to make any change whatever in the thermostat or other control settings when transition is made from the heating season to the summer season when domestic hot water is the sole function of the oil burner. The system is truly automatic.

Three principal advantages claimed for the year-round hot water hookup are: (1) a saving in cost of hot water generated; (2) greater convenience in operation as compared, say, with a coal-fired water heater, or with a manually operated kerosene-burning heater during the summer months; and (3), the fact that when a year-round hookup is used the burner operates in the summertime and presumably depreciation is minimized.

Effecting a saving in heating domestic hot water the year round with oil depends upon several factors, principally the relative cost of the different fuels that might be used and the quantity of hot water demanded. When compared with heating hot water with small-size coal heaters, it is doubtful whether any great saving can be made. As compared with using manufactured gas or electricity, at an average of rates throughout the country, the year-round heating of water by means of oil fuel should generally result in some saving, especially if a large quantity of hot water is heated. The Department of Agriculture has not had opportunity to make definite comparisons between the costs of heating domestic hot water with the year-round hot water hookup and with other modes.

Residential district of the kind the author envisions as the great undeveloped opportunity for central steam service. Photo by Galloway

The Case for Central Station Steam

By ROBERT L. FITZGERALD

The author states the case for the use of central steam against all its rivals. The point of view is most unusual. Mr. Fitzgerald is well known among utility steam men, is vice-president of the Duluth Steam Corporation and a past president of the NDHA at whose annual convention he presented a paper "A Future in Steam" from which this is briefed.

IF we can believe the statements of industrial and economic writers, there has been more pure thinking along lines of commercial and industrial research and development during the past three years than during any similar period of our industrial history. This is not hard to explain. Up to three years ago the big majority of thinking men were occupied with the problems of production and were so burdened with administrative and social duties that they had little time for pure thinking, or dreaming, as it is frequently called.

Since this depression set in, many able thinkers, possessed of knowledge, ability, and native ingenuity, have been forced by circumstances into idleness and seeming inactivity. The inborn human urge to be constructively occupied and the pressure of the necessity of life have combined to force many of these men to bring their native talents into use to create some new, or better, device or method for accomplishing some useful purpose so that they may again be productive units of society and share in the good things of life.

It seems strange indeed, considering the large number of mechanical engineers at liberty to spend much time in pure thinking, that some of this original thought does not turn in the direction of steam. One of the first things that the mechanical engineer learns about is steam; he is supposed to know what it is, how to make it, how to control it, what its properties are, and at least some of its uses. It is probably no exaggeration to say that steam is the bed-rock foundation of the mechanical engineering profession. Mechanical engineering started with Mr. Watt and his steam engine in 1769, and even to this day, except for an occasional water power, all of our mechanical engineering depends upon steam somewhere in the system for proper performance. It seems that mechanical engineers just take steam for granted, assume that its possibilities are completely exploited, and leave the subject entirely in the hands of the boiler room.

Steam is concentrated B.t.u.'s, and as such has uses for power, process heat, water heating, cooking, refrigeration, and last, but certainly not least, for space heating. As steam is net usable heat in its most concentrated and controllable form, it should be considered first in the solution of any problem requiring heat. If the requirements are beyond the practical temperature limits of steam, then, and only then, should other methods be considered.

Steam is so commonplace, so universally available, so generally taken for granted, that no one ever stops to measure the total quantity of steam used, or, what is infinitely more important, what should be and will be used when the mechanical engineers thoroughly develop the business. Figures are available to tell you the kilowatt-hours, the thousand cubic feet of gas, the gallons of water, the tons of coal, the gallons of sanitary sewage, per day per month, per year, per thousand population, but such figures are not available anywhere for the quantity of steam used. If you were assigned the task tomorrow of designing a complete steam system for supplying all of the steam for a city such as

Columbus, Ohio, you would have to make quite elaborate surveys to determine quantities before you could start the design.

The steam industry was started before the electrical industry and by comparison it has certainly been a laggard. The failure of the steam industry to grow and keep pace with the development of the country was not because it was not inherently just as sound economically and larger in magnitude than the electric business, but because the handicaps of its early start were too much for an industry to survive.

Many engineers and operators who have had some slight contact with the record of these early failures will state emphaticallly that central steam service is a proven failure. These engineers are too lazy mentally to do some original thinking on the problem and find out just why these original projects, operated with boiler efficiencies of 40%, built with the methods and materials, and merchandised with the steam meters of forty years ago, were failures. If these engineers will study this subject they will discover that the main causes contributing to these early failures were:

1st—The low boiler efficiencies
2nd—Low pressure distribution lines
3rd—Poor merchandising.

Means are now available to avoid every one of these errors in any steam system built today.

At the time these early records were written, the boiler efficiency of the central plant was about the same as that of the isolated plant; today it is about twice that of the small plant. This one difference is sufficient to completely reverse the economic results of the industry.

The investment banker to this day turns thumbs down on any proposed steam project, but this is not necessarily fatal. This group has made mistakes before. Much of the money that they advanced for traction lines, railroads, real estate projects, cross-country natural gas lines, foreign bonds and many industrial projects, would have been much safer had it been invested in steam distribution lines, in the urban centers.

For some few years in the recent past, the investment banker found it convenient to dispense with the well-established engineer's report on proposed financing; a balance sheet audit seemed to satisfy the requirements of a thorough investigation. However, as time passed the result was not so good, maybe an engineering investigation and report is essential to sound financial underwriting. In the next forward movement it is quite probable that an able and adequate engineering staff will be an established part of every good investment banking organization. As the steam business is bound to be an important factor in the financing of the future, the engineers that are to guide the bankers have an obligation to their profession to advise themselves thoroughly on the steam business, not as it was thirty years ago, but as it can be in the present state of technical and economical development.

Aside from the uncertainty of the future oil price situation, if the money is going to be spent to equip all the heating plants with oil burners, it will be found that for less total money invested, district steam systems could be built that would better serve the needs with lower operating costs.

Note some of the basic or underlying economies of central steam service.

The average seven-room house requires a heating plant to produce equivalent to 84 lb. of steam per hour or 2.45 rated boiler horsepower capacity. This rated capacity when supplied by central boilers, with permissible overload ratings of 300% is reduced to two-thirds and becomes 0.815 boiler hp. per house served. That is to say the central steam service requires only one-third as much installed capacity as is required by the individual plants. The investment in generating capacity is therefore only one-third what it is in the isolated plants. Part of this saving is offset by the investment in distribution. In any 80-ft. length of street there would be two houses, one on each side of the street. A fair average price for the heating plant, not including oil burners, in the basement would be at $500 each, $1000 for the 4.90 boiler hp. required, or a unit cost of $12.40 per ft. of street length, or $200 per boiler hp. of capacity.

In the central boiler plant this capacity would call for an investment of $30 per hp., a total of $148.50 or 89 cents per ft. of street length served. The average size main for residential districts would be 4 in. which could be installed for $8 per ft., or $640 for the 80-ft. length. This totals $788.50 or $9.89 per ft. of street served; this is less by $211.50 or $2.64 per ft. of street served than the individual plants cost. This $2.64 per ft. of street seems adequate to add the house service, and meter cost, and have some left to build the necessary feeder lines, and cross connecting mains. The point about this is that it is cheaper in investment cost to build the central plant than it is to build the individual plants.

Now as to operating costs. In this district $2.50 per ton is a fair average price of steam coal, and five dollars per ton is a fair average price for domestic coal, a ratio of one to two. This ratio is about right for many localities, although it is nearer one to three in the east where hard coal is the prevailing domestic fuel. In this item the central plant has an advantage of 50% in the cost per ton of fuel used.

The average efficiency of the central plant is something better than 80%, the average efficiency of the isolated plant is something less than 50%, the central plant has an advantage in operating efficiency of at least 30%, that accounts to a saving in quantity of 37½%. However, as the steam must be distributed from the central plant, part of this improved efficiency is lost in distribution. Taking a reasonable distribution efficiency of 85%, the overall efficiency of plant and distribution system is 67½%, compared with 50% for the separate plant. The saving in cost of fuel both as to price per ton and gain in operating efficiency is 67%.

Another item of expense that is very large is the cost of house cleaning, clothes cleaning, and laundry that are a direct result of individual heating plants. This is almost impossible to measure with any degree of accuracy.

The remark is frequently made that central steam service in the home will require scrapping all warm air heating plants now in service. Such is not the case.

Any space heating system is a warm air heating system. The main difference is the air is heated. For years the warm air heating systems in schools and theaters have been supplied with steam heat at a central location in the basement. The warm air for the home can be easily heated in the basement with steam, and such a method is simple and has many advantages.

In industrial and commercial districts the density of load is much greater, and the investment cost to serve with steam is less per unit of capacity or output. For this reason the commercial districts are looked upon today as the most profitable from the central steam standpoint, but the advantages about balance between the various classes of territory. All are entitled to and should be served with steam from a central system.

Load density per foot of pipe or per mile of street varies so widely, in commercial and industrial districts, that each district is a problem in itself for survey and determination of load and pipe sizes. Generalizing for purpose of demonstration is both difficult and hazardous. On the other hand domestic districts are very much alike from a steam standpoint and a hypothetical project for one mile of street is interesting.

Take one mile of built-up city residential street. It would have 132 dwellings that average seven rooms per house. Steam demand will average about 12 lb. of steam per hour per room or,

72 lb. per hr. for a six-room house
84 lb. per hr. for a seven-room house
96 lb. per hr. for an eight-room house

This mile of street with 132 dwellings would have a total steam demand of 11,000 lb. per hr., or 320 boiler hp. A 4-in. pipe built to serve this street, and having an initial pressure of 165 lb., would deliver this quantity of steam with a terminal pressure of slightly more than 100 lb. The investment, including plant, pipe line, meters and services, would be about $61,000 or $465 per house served.

The revenue from this investment would average:

For heating	$120.00 per year
For hot water heating	12.00 per year
For some cooking and refrigeration	12.00 per year
Total revenue per house	144.00 per year
Total revenue per year from 132 houses	$19,008.00 per year

This is a ratio of investment to revenue of three and two-tenths to one. This ratio will compare very favorably with the similar ratio for any other public service enterprise.

Factory Heated by Waste Heat from Diesel

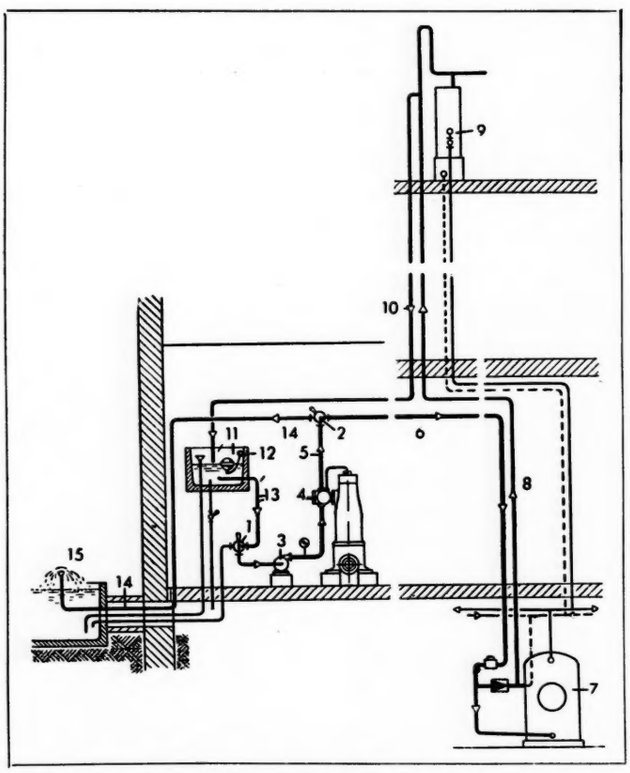


Fig. 1. Diagram of the piping layout for heating plant utilizing the heat from diesel cooling water.

1—Valve in cooling water piping to engine; 2—Valve in cooling water piping from engine; 3—Centrifugal circulating pump; 4—Outlet of hot cooling water from engine; 5—Hot water piping from diesel; 6, 8—Hot water piping; 7—Additional oil-fired heating boiler; 9—Expansion tank; 10—Return piping to hot water tank; 11—Hot water tank; 12—Automatic make-up; 13—Pipe to circulating pump; 14—Cooling water pipe from valve 2 to cooler; 15—Cooler with atomizing nozzles.

A SWISS spinning mill has just installed a 75-hp. two-cycle diesel engine, from the cooling water of which about 240,000 B.t.u. per hr. are supplied to a central heating plant.

In central Switzerland, heating is required on an average for about 200 days per annum. The central heating plant has to supply more or less heat according to the prevailing outside temperature. Very cold days are, however, comparatively few.

The quantity of heat supplied by the water from the engine is sufficient to warm the rooms during about 170 days of a heating period, equivalent to about 85% of the heat required for a full heating period of 200 days; consequently, only 15% has to be supplied from the boiler. Since the heat from the diesel engine costs nothing, the saving effected in fuel is considerable; it amounts to about 13 tons during each heating period. In most cases, therefore, the cost of the equipment can be written off in a year or two.

The results obtained with this plant have proved to be highly satisfactory, although the engine was occasionally only lightly loaded. The heating boiler had to be put in service only during the coldest nights and on Sundays, when the diesel was not working.

Fig. 1 shows diagrammatically how the piping is arranged. In summer, the cooling water system of the diesel engine is disconnected from the central heating system merely by turning the two valves 1 and 2. For circulating the engine cooling water in the central heating plant a small centrifugal pump 3 is installed. It is driven by belt from the diesel and delivers the cooling water from the engine into the central heating system close to the oil-fired boiler.

Summer Degree-Days for Predicting Air Conditioning Loads

By ANSON D. MARSTON†

The degree-day in winter is well established using a 65F base. It is usually argued that the base has to change if the degree-day is to be applied to summer air conditioning. The author, writing in the Bulletin of the Edison Electric Institute for May, 1937, reported on studies of summer loads in Kansas City, Mo., and found that the degree-day on a 65F base showed good enough correlation to suggest its suitability for summer use. As this is the first study of its kind reported and the first one known where 65F base is suitable, it is not thought that predictions of energy consumption should be attempted for cities other than Kansas City until further information on the subject is available.

YESTERDAY we of the utilities paused, predicted great things in the future for air conditioning, and then passed on to more pressing problems. Today this infant has "grown up." Whether we like it or not, this new industry is here—to stay. What are we going to do about it?

An example of the part air conditioning is beginning to play in system loads is furnished by the case of one middle-west utility. During 1936 this utility had a peak load of 107,000 kw., exclusive of the street railways load, which is served by a separate 25 cycle plant. This peak occurred in February. During the summer months the peak load was 97,000 kw.—at a time when the connected load of air conditioning customers was about 9000 hp. This question of peak loads is aggravated by the fact that the power factor of the winter peaks is around 89% to 90%, while that of the summer peaks is near 82%. On this basis, the winter peak is 119,500 kva., while the summer peak is 118,300 kva. In view of the higher condensing water temperatures and ambient temperatures in the summer, the load on the turbines, cables, and transformers is at least equal to that in the winter.

†Kansas City Power and Light Co.

Recently a survey was made of the territory served by this company, in an effort to estimate the air conditioning load which will be added to its lines in the next 10 or 15 years. This survey indicates the probable addition during this period of about 64,000 hp. in air conditioning equipment. There is every indication that in a short time this company will experience a decided summer peak—a radical departure indeed from past conditions! In addition to its other implications, a change of this nature will cause a sweeping change in a rate structure whose "On Peak" clauses are all based on a peak occurring in late afternoon on winter days.

This example is cited because it is typical of the conditions confronting many of our utilities. Some companies are active in promoting air conditioning; in general, these companies realize its possibilities and are studying its effect on their systems. Others have devoted little effort to its promotion and have few data available for such a study. Whether a utility be large or small, the questions involved are important enough to merit careful consideration.

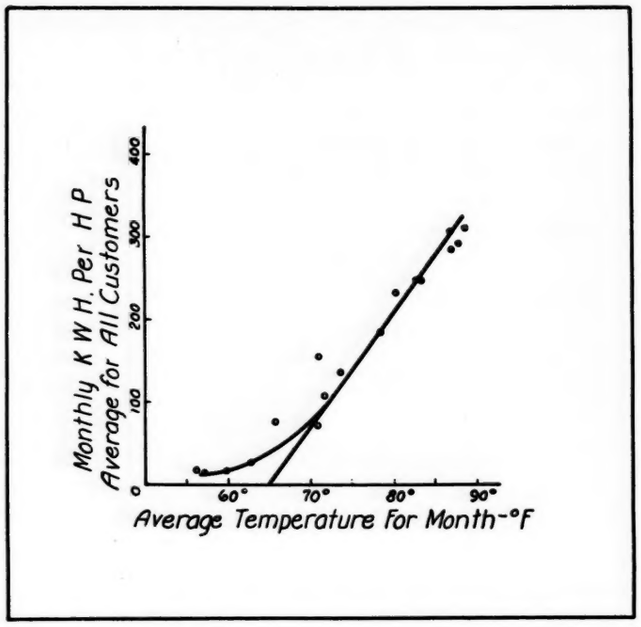
A study of this nature may be as elaborate or as simple as conditions warrant, but certainly one essential is an accurate record of existing installations.

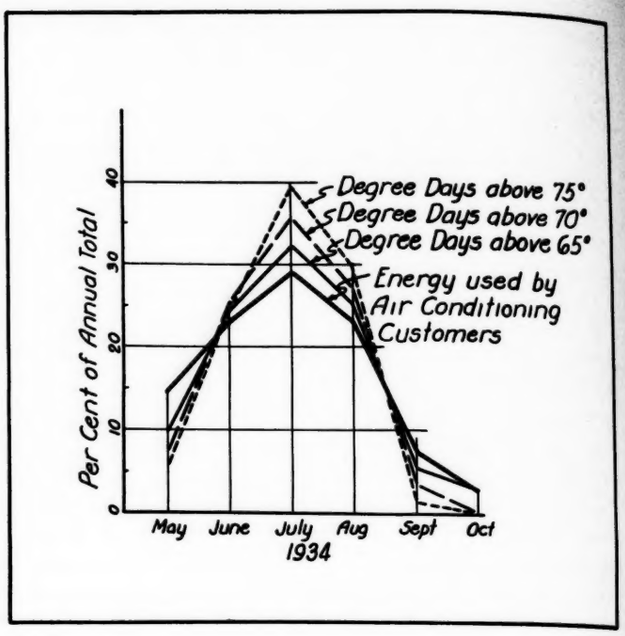
Some recent studies undertaken by the Kansas City Power & Light Company furnish an example of the uses which can be made of air conditioning records. For the last three years this company has prepared lists of the air conditioning installations in its territory. The list prepared at the end of 1936 shows a total of 9885 hp., divided as follows:

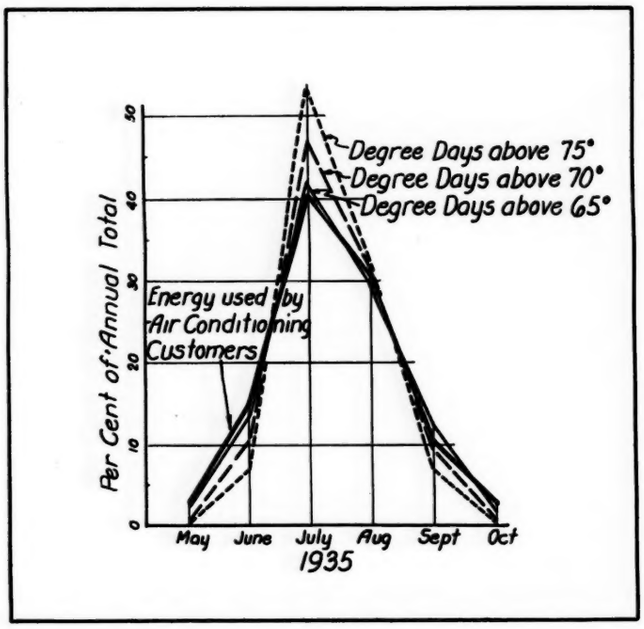
Department stores	466	hp.
Misc. retail stores	959	"
Offices	1,162	"
Public buildings	2,680	"
Hotels	698	"
Dairies and ice cream	7½	"
Restaurants, etc.	967	"
Hospitals	61½	"
Theaters	1,870	"
Misc. commercial	496	"
Residential	518	"
Total	9,885	hp.

TABLE 1—AVERAGE ELECTRICAL ENERGY CONSUMPTION OF AIR CONDITIONING JOBS IN KANSAS CITY
(Figures are in kilowatt-hours per horsepower, average)

	May	June	July	August	September	October	Total
1934							
All Installations	156	250	313	250	78	29	1076
Commercial Installations	184	265	314	253	80	31	1127
1935							
All Installations	18	109	307	234	78	19	765
Residential Installations	0	71	270	208	47	3	599
Commercial Installations	23	119	318	242	88	24	814
1936							
All Installations	72	185	294	289	138	15	990
Residential Installations	14	125	260	243	96	1	739
Commercial Installations	101	211	311	307	158	21	1109







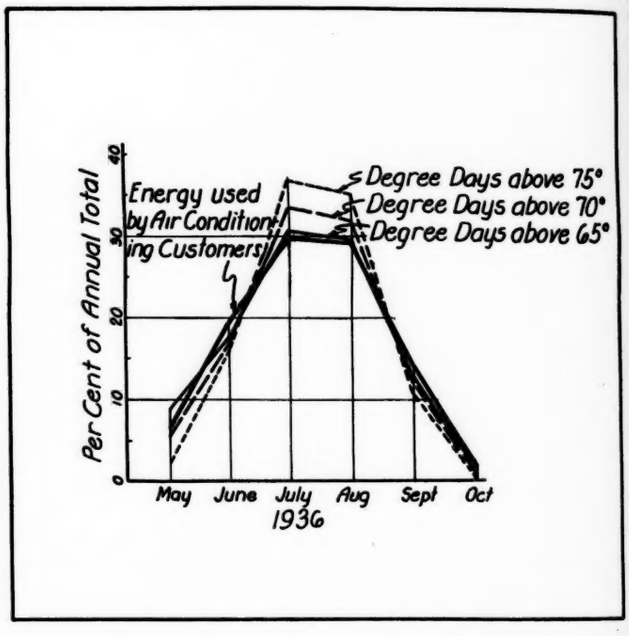


Fig. 1. (Upper left) Air conditioning loads plotted against average monthly temperatures for Kansas City. Fig. 2. (Upper right) Relation between degree-days at 65, 70, and 75F degree bases and electric energy used for summer air conditioning in Kansas City in 1934. Fig. 3. (Lower left) Relation between degree-days on various bases and power used by air conditioning plants in 1935. Fig. 4. (Lower right) Studies of 1936 power consumption of summer air conditioning plants in Kansas City showed relations similar to those shown in Figs. 2 and 3.

The task of determining the amount of energy consumed by these air conditioning customers is a difficult one. In most cases the meter serving the air conditioning equipment measures also the energy consumed by other equipment. For example, all residential installations of 3 hp. or less are added in with lights, refrigerators, and other appliances.

Fortunately a number of these customers are served on a special air conditioning rate. This rate, which was offered first in 1933, provides that the air conditioning equipment shall be served by a separate meter; this meter is disconnected on October 15 each year, and re-connected on May 1. As this is an *optional* rate, only 72 customers have used it long enough to furnish records of value in this study. Many of these furnish records covering a part only of the period 1934 to 1936, inclusive, but enough information is available for each of these years to serve as a basis for close study of the energy consumption during these years.

Table 1 shows a summary of the records obtained from these customers. Obviously there is a difference in summers which complicates the effort to forecast the revenue to be expected over a period of years from a group of air conditioning customers.

For a number of years the heating industry has used the figure for "Degree-Days Below 65F" as a basis for

similar estimates of heating requirements. These figures are used throughout the country, and they give satisfactory results.

Up to the present time no similar basis for estimating cooling costs has been devised. A few scattered studies have been made in an effort to determine such a basis, but in general these have been unsuccessful. For one thing, few data are available showing energy consumption for air conditioning systems prior to 1934.

From a theoretical point of view it might appear at a glance that no satisfactory common denominator for cooling costs can be found. The calculations of heating loads are fairly simple, and involve primarily two factors only:

1. Heat transmitted through walls, roof, floor, etc.
2. Heat loss due to infiltration of outside air.

It will be noticed that for a given building the heating load depends very largely upon outside conditions —i.e., weather factors.

The calculations necessary in determining the cooling load must take into consideration several additional items, which are largely independent of weather conditions. The calculations of *cooling loads* are usually divided into five items. These are:

1. Heat transmitted through walls, roof, glass, etc.
2. Heat resulting from the direct effect of sun light.
3. Heat and moisture from infiltration and other outside air.
4. Heat and moisture due to the presence of human beings.
5. Heat load from special equipment—motors, lights, appliances, etc.

A study of this list will show that the first three items depend upon outside weather conditions, although Item 2 is not covered in normal weather bureau reports. The other two items are entirely independent of outside conditions, and frequently constitute a major portion of the load.

In spite of the variety of items involved it will be shown that there exists a definite relationship between energy consumption and normal weather data. By the use of this relationship it is possible to estimate with reasonable accuracy the revenue to be expected from air conditioning customers.

Originally the base temperature of 65F was selected for use in estimating heating requirements by plotting average steam consumption against average monthly temperatures. When this is done the points obtained fall reasonably close to a straight line and indicate that steam consumption is directly proportional to the difference between 65F and the average monthly temperature.

Following this line of attack Fig. 1 was drawn, plotting monthly energy consumption against average monthly temperatures. It will be noticed that the points shown in this curve fall reasonably close to a straight line and indicate that energy consumption is directly proportional to the difference between 65F and the average monthly temperature.

In preparing this figure it was noticeable that a number of months with low average temperatures had in them spells of a week or more of hot weather, with consequent energy consumption. These months do not follow the trend indicated by warmer months. For example, September, 1934, had an average temperature of 65.8F, although it contained seven days with maximum temperatures of 85F or higher.

Fig. 1 is based on the *average* consumption of a large group of customers. When similar figures are drawn for individual customers they follow the same pattern, but indicate base temperatures varying from about 60F, in the case of restaurants and other customers with heavy loads for people, lights, etc., to 70F in the case of residences and other customers where weather is the major factor.

Where this study was started it was expected that the base temperature would be 70F or higher. The indicated base of 65F is so much lower than expected that additional studies were undertaken as a verification. In Figs. 2, 3, and 4 are plotted the per cent of the total annual energy consumption occurring during each month of the three summer seasons studied. In the same figures are shown the monthly variation in "Degree-Days Above 65F," above 70F, and above 75F. These figures show very clearly that the variation in energy consumption follows closely the variation in "Degree-Days Above 65F"; also that there is much better agreement with "Degree-Days Above 65F" than with degree-days above the other base temperatures. As an additional check, similar curves were drawn to a large scale and the degree-days for the intermediate bases were included. These additional curves verify the use of 65F as a base.

Fig. 5 shows the monthly energy consumptions plotted against the monthly "Degree-Days Above 65F." It will be noticed that the points obtained in this manner fall surprisingly close to a smooth curve. May, 1934, is the sole exception to this statement. For this month the collection of records was just beginning, and the number of customers included quite small. (For this month the totals are 221 degree-days and 156 kw-hr. per hp.)

Although it appears from these investigations that the figures for "Degree-Days Above 65F" can be used satisfactorily in estimating the revenue to be expected

TABLE 2—NUMBER OF DAYS IN KANSAS CITY WET BULB TEMPERATURE EQUALED OR EXCEEDED GIVEN TEMPERATURE

(Wet bulb readings used were, 7 a.m., noon, 7 p.m. or highest, for each day from May 1 to Oct. 15, incl.)

Wet Bulb Temp., F	1933	1934	1935	1936
60	139	137	119	139
61	136	134	114	132
62	136	127	112	124
63	132	120	108	120
64	121	112	106	119
65	111	109	104	116
66	103	99	97	108
67	100	96	90	102
68	88	91	85	92
69	81	85	82	86
70	73	78	75	78
71	64	70	66	72
72	54	53	59	67
73	45	44	51	54
74	34	32	46	43
75	24	21	39	24
76	15	14	32	10
77	8	8	20	2
78	5	—	12	2
79	1	—	6	—
80	—	—	3	—

TABLE 3.—NUMBER OF SUMMER DEGREE-DAYS (ABOVE 65F), FOR KANSAS CITY, MO.

Year	May	June	July	August	September	October	Annual Total
1890	75	363	481	268	81	21	1,289
1891	36	220	230	276	215	40	1,017
1892	28	306	339	359	172	52	1,256
1893	48	245	393	264	254	59	1,263
1894	99	300	363	410	173	52	1,397
1895	131	242	290	322	308	0	1,293
1896	169	241	385	390	100	12	1,297
1897	79	322	478	309	368	103	1,659
1898	102	331	379	368	240	43	1,463
1899	124	282	346	446	174	113	1,485
1900	122	270	378	470	231	81	1,552
1901	66	418	683	440	190	46	1,843
1902	174	182	390	349	47	32	1,174
1903	84	155	424	309	130	25	1,127
1904	52	188	306	285	202	39	1,072
1905	60	311	290	411	184	42	1,298
1906	147	254	327	393	239	13	1,373
1907	58	219	419	367	157	15	1,235
1908	140	205	351	332	261	34	1,323
1909	52	252	397	481	160	68	1,410
1910	30	240	429	323	158	76	1,256
1911	224	469	443	404	268	24	1,832
1912	179	187	461	380	204	33	1,444
1913	120	349	512	633	205	58	1,877
1914	138	406	488	410	186	38	1,666
1915	82	163	299	183	190	29	946
1916	123	181	569	437	157	46	1,513
1917	40	250	462	257	154	20	1,183
1918	173	451	424	577	70	58	1,753
1919	56	329	524	358	234	53	1,554
1920	74	255	368	268	203	71	1,239
1921	187	363	498	372	260	29	1,709
1922	87	377	373	422	240	68	1,567
1923	63	274	445	389	154	5	1,330
1924	29	227	302	412	74	76	1,120
1925	93	347	423	409	324	21	1,617
1926	163	231	431	435	204	19	1,483
1927	83	191	372	207	278	71	1,202
1928	132	132	418	384	123	91	1,280
1929	72	246	421	412	146	20	1,317
1930	81	256	550	474	232	65	1,658
1931	87	438	519	344	385	85	1,858
1932	126	347	507	422	146	25	1,573
1933	124	507	491	344	336	19	1,821
1934	221	545	721	568	122	62	2,239
1935	36	220	675	483	199	31	1,644
1936	203	406	706	680	304	35	2,334
Totals	4,872	13,693	20,480	18,236	9,442	2,118	68,841
Average	104	291	436	388	201	45	1,465

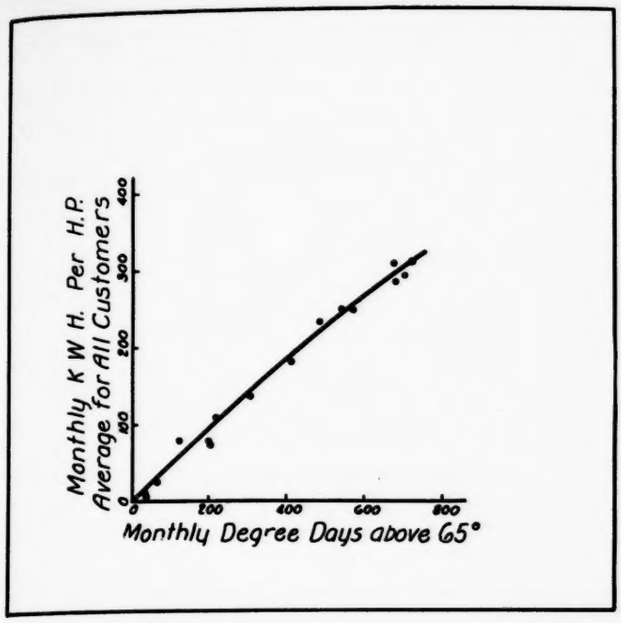
from air conditioning customers, the important factor of relative humidity has been entirely neglected. Consequently it appears desirable to check to see whether the outside wet bulb temperatures, as shown by weather bureau records, have any traceable effect on energy consumption.

TABLE 4.—SEASONAL TREND OF ENERGY CONSUMPTION FOR AIR CONDITIONING, KANSAS CITY

Month	Normal Number of Summer Degree-Days	Normal Kw-hr. Per Hp	Normal % of Annual Total
May	104	51	7.4
June	291	137	19.9
July	436	201	29.2
August	388	180	26.1
September	201	97	14.1
October	45	23	3.3
Total	1,465	689	100.0

Table 2, compiled from weather bureau records, shows the number of days each year during which the outside wet bulb temperatures equaled or exceeded various figures. A comparison of Table 2 with Table 1 will show that the maximum energy consumption occurred during the years with lower wet bulb temperatures. Thus it appears that relative humidity does not have enough effect on energy consumption to be taken into consideration in a study of this kind.

As a possible explanation of this lack of correlation between relative humidity and energy consumption, the great majority of all air conditioning systems in this



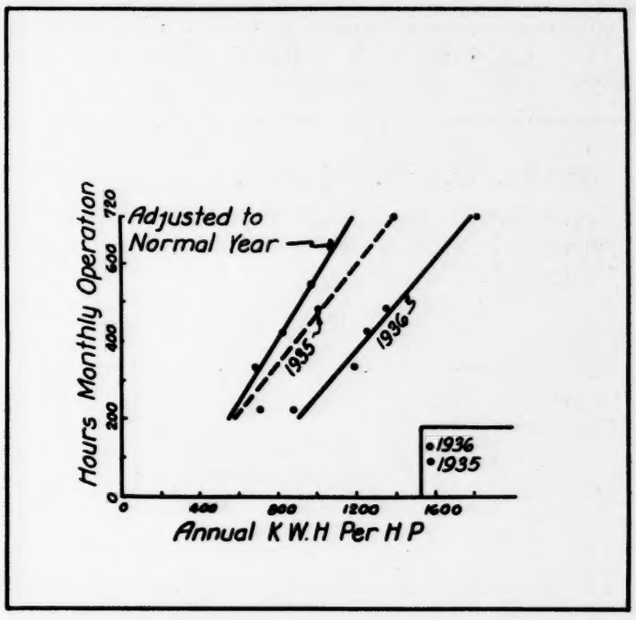


Fig. 5. (Left) Monthly electric energy used for air conditioning in Kansas City plotted against monthly degree-days above 65F. Fig. 6. (Right) Curves showing the annual kilowatt-hours per horsepower in Kansas City in 1935 and 1936 with curve plotted to indicate a "normal" year.

locality is controlled by thermostats, with no provision for humidity control. Customers are in the habit of watching thermometers, without paying attention to relative humidity. Probably an industrial installation, where humidity is controlled with relatively narrow limits, would show a closer relation.

The studies outlined above appear to show clearly that the revenue to be expected from a group of air conditioning customers can be estimated from past records with reasonable accuracy by the use of the figures for "Degree-Days Above 65F." Table 3, which has been compiled from local weather bureau records, shows these figures for the past 47 years. This table gives some idea of the amount of variation which can be expected in energy consumption.

By using the figures for average monthly degree-days, as obtained from Table 3, it is possible to get from Fig. 5 the average energy consumption for each month of a normal year. These figures are shown in Table 4, which indicates that for a normal summer the energy consumption of air conditioning installations in Kansas City should average 689 kw-hr. per hp.

This information is of value to a utility estimating the revenue to be expected from a large group of air conditioning customers, but it is incomplete in that it does not include any factor for the hours of daily operation. In an effort to take this factor into consideration, Fig. 6 was drawn. In this figure the average kilowatt-hours per hoursepower used during 1936 by those customers operating 720 hr. per month is shown as one point. Similar points are shown for other classes of operation, and a curve is drawn showing the relationship existing in 1936. The two customers operating 540 hr. per month were ignored in drawing the curve, because for various reasons they are not representative installations.

A similar curve is shown for 1935, although the data for 1935 are less complete than for 1936. By adjusting the points on these two curves to normal, using the variation between actual and normal "Degree-Days Above 65F," the line marked "Adjusted to Normal Year" is obtained. The points on this line are listed in tabular form in Table 5.

By using Tables 4 and 5 it is possible to estimate with reasonable accuracy the probable energy consumption of a given customer during a normal summer. For example, assume that a customer operating twelve hours a day, Sundays included, is installing 25 hp. in air conditioning equipment. From Table 5 it is seen that the total energy consumption should be 745 kw-hr. per hp., or 18,625 kw-hr. per year. From Table 4 this should be divided as follows:

TABLE 5.—ENERGY CONSUMPTION VS. HOURS OPEN PER MONTH
(Based on Normal Year)

Hr. Open per Mo.	Hr. Possible Operation per 6-Mo. Season	Kw-hr. per Hp.	Hr. Actual Operation (1 Hp. = 0.9 Kw.)	% Actual Is to Possible
720	4,320	1,200	1,332	30.8
660	3,960	1,120	1,120	31.4
600	3,600	1,050	1,165	32.4
540	3,240	975	1,083	33.5
480	2,880	895	994	34.5
420	2,560	820	911	35.6
360	2,160	745	828	38.3
300	1,800	670	744	41.3
240	1,440	590	656	45.5
200	1,200	540	600	50.0

May	7.4%	1,380 kw-hr.
June	19.9%	3,700 "
July	29.2%	5,440 "
August	26.1%	4,860 "
September	14.1%	2,630 "
October	3.3%	615 "
Totals	100.0%	18,625 kw-hr.

ABSTRACTS of Current Papers, Books and Pamphlets

Heat Loss Through Windows

Investigations on the heat lost through windows have been carried out within the past ten or twenty years in the ASHVE Research Laboratory at the United States Bureau of Mines, Pittsburgh, at the Universities of Illinois, Wisconsin, Michigan and California. In Europe, similar work has been reported from the Building and Fuel Research Stations of the Department of Scientific and Industrial Research in England, and in Germany from the Institutes of Technology at Danzig, Darmstadt, Munich, Stuttgart, and from other centers.

A small amount of work has been devoted to the determination of the heat transmission of windows, and many more tests have been made in order to determine the amount of heat lost because of the leakage of cold air into the house through the cracks around the sash or window frame.

A review of the literature on this important subject has been prepared by the Division of Research Information of the National Research Council at Ottawa. The report gives a brief account of practically all the recent investigations on heat losses through windows in dwelling houses. Although books on heating and ventilation contain tables and graphs for computing these losses, the information which they give refers to certain unstated average conditions which may not always obtain in practice. Hence, knowledge of the work by means of which the accepted results were obtained gives a better understanding of their usefulness and their shortcomings as well as of the extent to which they apply to Canada. Because of the extreme climatic conditions that prevail in that country, house windows should, on an average, provide twice as much heat insulation and admit rather more light than windows in houses located in the same latitudes in European countries.

The purpose of the report is to awaken interest in this subject, and it is hoped it will lead to an exchange of opinion as to how the best results may be achieved.

[*"Heat Loss Through Windows," by R. Ruedy. Published by the Research Information Service of the National Research Council, Ottawa, Canada. Paper cover; 8½ x 11 in.; 38 pages. Available on request.*]

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Water Temperatures

There are numerous publications, especially those of the United States Geological Survey, which give data regarding quantity and quality of surface and ground water obtainable at different points in the country. There is, however, only one publication so far as we know which gives information on the temperature of ground and surface water. This publication, originally issued in 1925 by the Geological Survey, proved so useful, with resulting great demand, that the supply of copies has long since been exhausted. Fortunately it has been reprinted and is now again offered for sale.

The booklet contains five pages of text and includes a double page fold-in map showing the approximate temperature of water from shallow wells throughout the country while a similar map shows the approximate temperatures of surface waters during July and August. Two large fold-in graphs illustrate the correlation between surface water and air temperatures at different localities. A table gives mean monthly temperatures of both water and air for 21 cities, the records covering a number of years in most cases.

[*"Temperature of Water Available for Industrial Use in the United States," by W. D. Collins, Chemist in Charge, Quality of Water Division, U. S. Geological Survey. Size 6 x 9 in.; available from the Superintendent of Documents, Washington, D. C. Price, 10c.*]

●

Refrigeration Engineering

The author of this book is well known for his previous work on the same subject, "The Handbook of Mechanical Refrigeration." Because of his excellent coverage of this subject and because of its clear explanations of refrigeration theories, his previous book has been widely read and accepted in the refrigeration field.

This new book treats the subject in a slightly different manner than the first, from the standpoint of the senior and graduate college student. The author's long and varied experience in the teaching of refrigeration to these men has given him an insight as to the best methods of presenting the material. He has found that unless refrigeration theory is thoroughly treated, the student will not understand the refrigeration cycle.

Because some knowledge of thermodynamics is needed to correctly understand the engineering of refrigeration, a short review of this subject is included in chapter 2. Chapter 3 is devoted to a discussion of the various refrigerants, their use and properties. In chapter 4 is an explanation of the flow of fluid and heat transfer to metal surfaces. Heat leakage into buildings, infiltration and insulation are taken up in chapter 5 and various parts of the refrigerating machine, such as condensers, evaporators and coolers are explained in chapter 6. Data on water supply are also presented in this chapter. Piping and fittings are covered in chapter 7. Actual refrigerating machines are discussed in the next two chapters—chapter 8, the absorption system; chapter 9, the compression system. Subjects covered by other chapters include automatic refrigerating machines, erection, operation and testing, air conditioning, comfort control and sound control, cold storage, ice manufacture and special applications of refrigeration engineering.

[*"Refrigeration Engineering," by H. J. Macintire, published by John Wiley & Sons, Inc., New York; cloth cover; 6 x 9 in.; 415 pages; price, $4.50.*]

(Abstracts concluded on page 78)

WHAT READERS SAY• • •

Thermostats

In any heating system or general air conditioning system which is arranged to maintain a given degree of temperature automatically through the use of thermostats located in the areas where the heat is furnished or the air is conditioned, considerable thought and care should be given to the location of the thermostat relative to the temperature for which it is set. The reason for this is very plain. The air in any given enclosed space is warmer near the top of the space or the room than near the floor, and the change is, of course, progressive. The coolest point is at the floor, and the warmest place is at the ceiling.

It follows that if one takes two thermostats which are set for the same temperature, locating one of them 3 ft. from the floor in one room, while the other is placed at a height of 6 ft. from the floor in another room, there will be different results obtained. The room which has its thermostat located higher will not be as warm as the one which has the thermostat lower.

Actually, location of a thermostat at 3 ft. above the floor, when it is set at proper temperature will be nearer right than one 6 ft. high, particularly in places where the most of the workers are seated the larger part of the time. In general, it might be said that an error is seldom made on the side of getting the thermostat too low. If you must locate it 6 or 7 ft. above the floor, set it for a temperature five or six degrees higher than would be ordinarily desired.—*John E. Hyler, Peoria, Ill.*

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Our Error

In your June issue you printed an article on the air conditioning system for the National Aluminate Corporation, by Robert E. Hattis, in which you stated that the steamfitting work was done by the Modern Plumbing & Heating Co.

This is an error and should be corrected to Northern Plumbing & Heating Co. . . .—*A. R. Nilson, Northern Plumbing & Heating Co., Chicago, Ill.*

●

Corrosion

We are having considerable trouble with pitting and corrosion in our underground lines which bring condensate returns from the building heating systems back to the heating plant. The most of our trouble has been in the line from the gymnasium. We just recently took out some extra heavy fittings which were entirely eaten through by the corrosion. We are trying to figure why we should have more trouble in the gym line than in any other line. We have a steam hot water heater in the building. On two occasions the packing around the tubes has leaked which has allowed city water to leak into the steam space and, therefore, to be brought back to the boiler room in the return line. On one occasion this leak went on for several days before we discovered it. We think it might be possible that the mixing of the city water with the hot returns might be at the bottom of the trouble. We can think of no other reason why we should have more trouble with the line from this building than in the lines from others.

Do you have anyone who might from other similar experiences venture an opinion as to the cause of our trouble and suggest a remedy?—*R. P., New York, N. Y.*

[Opinions submitted will be gladly forwarded.—Ed.]

●

"Load Units"

Inasmuch as you have been interested in our use of the School Degree-Day, I thought you might also like to know of a further use to which we have put this factor . . . We have developed what we call the "load unit," representing the heating load of 1,000,000 cu. ft. of heated space for one School Degree-Day. In this way we obtain a value which includes a measure of the size of a building, as well as the outside weather conditions. We therefore can make comparisons between buildings for the same or different years, and with the same or different fuels. The value of 1,000,000 cu. ft. of heated space was arbitrarily chosen in order to obtain a final value of load units which would not be too great a number. The volume of heated space was chosen rather than square feet of floor area since we have found that it more nearly represents the heating load when various types of rooms, such as auditoriums, gymnasiums, and cafeterias, are included along with classrooms.

The "load unit" method, of course, assumes similar building construction and similar use of the building being compared. It happens in our case that all of our structures are very similar in general type, but we do have a variation as to hours of use and general program. We accordingly have to keep in mind variations in program and use when making comparisons between different buildings.—*Howard Barker, Supt. of Buildings, The Board of Education, Salt Lake City, Utah.*

Editor's Note: Mr. Barker is the originator of the unit "School Degree-Day"—the number of degree-days occurring on Mondays to Fridays, inclusive.

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Owens-Illinois Laboratory

We read with pleasure in the July issue your description of the air conditioning system for the Research Laboratory of Owens-Illinois Glass Co., Newark, Ohio. We were quite disappointed, however, that neither the E. K. Campbell Heating Company was given credit for furnishing the equipment, nor were we listed as architects and engineers of the project . . .—*C. W. Foster, Foster Engineering Co., Ltd., Indianapolis, Ind.*

EDITORIALS

Summer Estimating Units

Ever since summer cooling plants in any numbers have been in operation there has been interest in a measuring unit proportional to their energy consumption in the same way that the degree-day is proportional to fuel consumption in winter plants. Many suggestions for such a unit have been made but there has been a lack of knowledge as to how such units would really meet operating conditions. In this issue is a paper by Anson Marston who shows that in recent years in Kansas City, Mo., the energy consumption on a group of air conditioning plants was proportional to the degree-days on a 65F base. It should be kept in mind in connection with this paper that the proportionality is shown for Kansas City only, for a few seasons only, and for a limited number of installations.

Also in this issue we print degree-hours above 85F in a number of important cities. There is some evidence that this unit bears a proportionality to the summer cooling load of residences. There is no evidence as yet that it is generally applicable, or that proportionality to energy consumption can be generally assumed.

We do not feel that it is necessary to state that the publication of Mr. Marston's paper and of degree-hours above 85F means that the problem of a proportional unit has been solved. It probably has not, but Mr. Marston's showing of a proportionality and our presentation of systematically computed unit figures shows that we are probably on the track toward the answer. What is needed most now is more confirmatory information drawn from field operating results. In the meantime the degree-hour figures are an acceptable index of the comparative severity of the summer weather. We believe that the very fact that these figures are available will help stimulate comparison against operating records of energy consumption in those cities for which the figures are printed.

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Training Personnel

Even during the worst of the depression some leaders foresaw and called attention to the likelihood that a lack of trained personnel would become apparent with a return of general business to anything approaching normal levels. The correctness of this viewpoint is now apparent. Nowhere is this lack more noticeable than in the building industry where both employment of new help and training programs were almost totally non-existent for several years following 1931.

During that time both methods and equipment changed markedly, especially so far as heating and cooling are concerned. Many of those formerly engaged successfully either lost touch with the field or failed to keep up. They needed training in order to re-enter. The result has been a noticeable shortage.

Now training classes have been started, renewed, reorganized, and enlarged. Many manufacturers have moved individually to meet their own training needs. Others have encouraged, patronized and depended on the many private and public training programs. While there are no exact figures available there is little doubt that this year is seeing more organized activity in training salesmen, engineers, mechanics, and skilled trade apprentices than ever before.

From most angles this is highly desirable. There is probably no such thing as an oversupply of really good personnel on which to draw. There are some responsibilities connected to this training business, though. One of them is to see that the story of the opportunities for employment is honestly told. Another is to guard against filling the training facilities with second-rate men. Generally, training programs under the control of experienced teachers and educators produce better results than those newly conceived. Our belief is that things have reached a stage where the worst edge has been taken off the shortage and where it may pay to go slow, especially so far as technical training is concerned.

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Air Conditioning Publicity

Air conditioning, especially cooling, is still regarded as news, and newspapers continue to take delight in printing stories of oddities concerning it. One of the recent ones which came to our attention was a case where striking employes included the furnishing of cooling among their demands for improved working conditions. Then there was the story about the failure of the cooling plant in one of the big new government buildings in Washington said to have been caused by fish clogging up the cooling water lines. Especially laughable and well played up was the story of the lady from one of the New York boroughs who rented a cooled room in one of the more expensive hotels so that her pet dog's asthma could be relieved during the hot weather. While the reporters may not be qualified experts their opinions are at least of interest, and they seemed to agree that the dog was doing pretty well when interviewed.

Every once in a while we get a communication or hear a comment from someone in the industry to the effect that something ought to be done to stop all such stories from being printed. We just can't agree with such a point of view. For one thing it is very doubtful if anything very effective could be done without more harm than good. Then, too, we don't see why there is any need to be alarmed about such stories anyway. They are good publicity and keep the subject in popular attention. But the chief point is that summer cooling would rest on a pretty flimsy foundation if it couldn't stand a little good-natured kidding. We are firmly convinced that the demand for summer cooling is here to stay, that it rests on a real foundation and that the time has long since passed when a few unfavorable news stories could seriously interfere with its progress.

NEWS OF THE MONTH

Water Supply Affects A.C. Sales in 7 Cities

WASHINGTON—Increasing use of air conditioning apparatus in the United States with a resulting demand for increasingly large quantities of water much of which when used once is discharged into sewerage systems is a matter of growing concern to officials of many municipal governments, according to the Marketing Research Division, Department of Commerce.

Installations of air conditioning units have increased approximately 1400% from 1933 to the end of 1936 and horsepower increased from 168,880 at the end of 1932 to 432,796 at the end of 1936, yet the trend of air conditioning sales continues upward more sharply than in any past year. Consequently, the need for water for this purpose is a matter of serious consideration to manufacturers and city water authorities alike.

Certain cities including Atlanta, Chattanooga, Columbus, Dallas, St. Paul, Scranton, and South Bend are now using the full capacity of their water systems and are not in a position to furnish additional water until the systems have been enlarged, according to the study.

Many other large cities throughout the United States are now using from 75 to 90% of available water capacity and could not readily furnish additional large quantities of water for purposes other than those now using water without arranging for increased capacity, it was pointed out.

N. Y. Building Code Approved

NEW YORK—The proposed building code for New York City which has been pending for the past eight years was approved by the Board of Aldermen July 21. Subject to approval by Mayor LaGuardia, the code will go into effect January 1, 1938.

Adoption of this code will mark the first time in 21 years that New York City has put into effect a new building code. The code will allow fusion welding in structural steel framework and it is claimed that in many other respects it will allow low cost methods of construction heretofore prohibited.

Inspection for Installations

LEASIDE, ONT.—This town, on the eastern outskirts of Toronto, has passed the first concise heating bylaw to be written and enforced in Canada. The law contains rules as to the installation of all types of warm air and hot water heating, including air conditioning, clearly defines certain limitations and boundary lines beyond which unscrupulous and irresponsible builders or contractors must not pass.

Each boiler, furnace, or other piece of air conditioning equipment must have attached to it securely and conspicuously a certificate from an inspector bearing full information as to the class of material used in the job as well as the name, address, and telephone number of the licensed installer.

A.C. Church for Houston

HOUSTON, TEXAS—Among the 43 air conditioning installations installed in this city during May was a 40-ton job in the Annunciation Church. Other large jobs included Bluebonnet Theater, 60 tons; Continental Can Co., 40 tons; and the Rainbow Theater, 46 tons.

More A.C. Cars for Vacation Service

WASHINGTON—Railway tours in air conditioned coaches at slightly more than a cent a mile are the newest summertime lure for vacationists, according to William B. Henderson, executive vice-president of the Air Conditioning Manufacturers' Association.

The first of 50 de luxe air conditioned coaches being built by the New York Central have been put into service on the Empire State Express. Sixty air conditioned coaches are among equipment just put into service by the Pennsylvania railroad, Mr. Henderson said.

The Northern Pacific has placed similar equipment in its North Coast Limited. The Atlantic Coast Line and the Louisville & Nashville have just inaugurated additional air conditioned coach service between Jacksonville and Cincinnati. The Nashville, Chattanooga & St. Louis railway has completed conditioning all its main-line equipment. The Central Vermont has installed new air conditioned coaches.

The Missouri Pacific has every passenger car owned by it air conditioned or in the shops being equipped. The New Haven has put 100 new air conditioned coaches into service and has 50 more on order. The Lackawanna is adding 20 conditioned coaches. The Milwaukee's Chicago-Green Bay-Iron Mountain division has new streamline locomotives hauling air conditioned coaches. The Boston & Albany has added 17 conditioned coaches and the Pittsburgh & Lake Erie eight.

The Canadian National Railways purchased 50 new coaches to be put into service this summer, all air conditioned. The Canadian Pacific is adding 141 air conditioned passenger cars, part for the company's four lightweight trains between principal cities of the Dominion.

The old St. Louis Union Station now has air conditioned waiting rooms, ticket offices, lunch counters and restaurants. The Union Pacific has just awarded a contract for air conditioning its 12-story headquarters building in Omaha, at an estimated cost of more than $250,000, said to be the largest project of its type west of the Mississippi.

Hatch Talks on Dust Control

CLEVELAND—The Dust Control Equipment Association at its meeting here recently gave careful attention to reports from the engineering committee of the association dealing with work in establishing standards of dust control practice, need for which has existed for some time.

The association endorsed the recommendations of the engineering committee with regard to the adoption of a friction chart and the development of a formula for use in connection with that chart.

During the meeting the association was addressed by Theodore Hatch, associate dust control engineer, division of industrial hygiene, Department of Labor, State of New York, on "Importance of Modern Standards and Methods of Dust Analysis upon Design and Efficiency of Dust Control Equipment."

Mr. Hatch, who spoke in the light of his personal knowledge and opinions rather than as representing the rules and regulations of the division of industrial hygiene, discussed methods used in cleaning dust from air in South African gold mines. He went into detail on the question of the size of dust particles and the relative importance of the different kinds of dust. He then discussed various types of equipment available for determining dust count and showed why he considered it unsatisfactory to attempt to establish factors on the basis of a very close determination.

Hotels Survey Effect of A.C. on Their Business

ST. LOUIS—The importance of air conditioning, and its probable effect upon the habits of the individual, were revealed in surveys conducted by the Mayfair and Lennox hotels in St. Louis, which have recently been air conditioned.

What the hotels wanted to know was: (1) Would extensive air conditioning of hotel rooms and shopping places increase the volume of travel by bringing guests into the city who otherwise would shop in their home town? (2) Would the air conditioning of hotels be a real help to the sales departments of large manufacturers, and, if so, in what way?

Since newspaper editors in small towns know a great deal about the habits and opinions of the local residents, the hotels sent a questionnaire to newspaper editors within 150 miles of St. Louis. They were asked: Would the air conditioning of hotels, shops, and restaurants in large cities result in more frequent visits to them by residents of smaller towns near by?

Results were surprising. Not only did a majority of the editors answer the questionnaire—in itself unusual—but 82% answered yes.

As to the importance of air conditioned hotel accommodations for salesmen, a questionnaire was sent to sales managers of large firms scattered throughout the United States.

Their answers showed that: 85% felt that a salesman's efficiency was increased by a night spent in an air conditioned room; 64% believed that if air conditioned rooms were available in warm cities, salesmen would do a better job there, and would be less likely to hurry out of town without making adequate calls; and 63% believed that sales were increased when salesmen had air conditioned hotel facilities in which to entertain clients.

Further, 45% of the firms questioned said that their salesmen were urged to take advantage of air conditioned hotel rooms whenever they were available. Ten per cent did not answer this particular question, and many of the sales managers who answered "No" on this query qualified their answers by explaining that few such rooms were available in their territory, or that it was left to the discretion of the individual salesman.

Herkimer Appoints Schulz

NEW YORK—Herkimer Institute, 1819 Broadway, this city, has placed John W. Schulz in charge of its classes in oil heating and burners. Mr. Schulz is well known for his technical work in the automatic heating, fuel oil, and oil burner fields. His system of automatic fuel oil deliveries is used by numerous oil companies, and his personal and written service and installation instructions are used throughout the burner industry. Mr. Schulz continues as technical adviser for several large oil companies and manufacturers of heating and oil burner equipment.

Heating Engineer Leaves Million Dollars

BOSTON — Under the will of Alfred H. Sawyer, Concord, heating engineer and manufacturer, a fortune estimated at over one million dollars has been left to business associates, friends, employes and distant relatives. His estate is divided into two parts, the income from $800,000 being distributed among these legatees as long as they live. On their death the Massachusetts Institute of Technology, from which the testator was graduated as a heating engineer in 1888, will receive one half of the principal.

British Introduce Air Conditioned Cubicles for Tropical Countries

LONDON — Interesting details of a portable cubicle coupled with an air conditioning plant suitable for use in tropical countries were given at a recent meeting of the Ross Institute Industrial Advisory Committee in London.

Major Lockwood Stevens stated that Dr. G. P. Crowden, of the Department of Industrial Physiology, had visualized the possibility of such an air conditioned cubicle four years ago.

"In the basement of the School of Hygiene," said Major Stevens, "there is a room in which can be reproduced and maintained temperatures and humidities similar to the climatic conditions in Lagos, Assam, Singapore, or elsewhere. In this room experiments are carried out on problems of air comfort arising at such places. A cubicle like the cabin of a ship is installed, in the midst of tropical heat and humidity, in which one can sleep, read, or work at a temperature reduced to perfect comfort.

"It is hoped that the whole cost of the installation will be about £100 to £150 ($500 to $750), and that it will shortly be available to residents in tropical countries.

"It means that a planter or miner can receive a few packing cases, reassemble the contents inside a room in his bungalow or office, plug in to an electric point, and he will have a refuge from the heat. The electricity cost will be about the same as that for a domestic refrigerator."

At a demonstration given for scientists and the press those present entered a room in which Nigerian weather conditions had been produced and they experienced all the discomforts of such a climate. Then they entered the air conditioned cubicle in the middle of the chamber and experienced the contrast of a cool, healthful atmosphere. Here a man could work during the heat of the day, a thing impossible under natural Nigerian conditions.

Springfield Dealers Elect

SPRINGFIELD, MASS.—The Springfield Oil Burner Association held a dinner meeting June 16 to elect new officers and to hear a presentation of the Oil Burner Institute regional program by G. Harvey Porter, OBI managing director.

Mr. Porter outlined the reasons for voluntary cooperative activities, pointing out that the most practical program of any key market group comprised a review of all practises and the adoption of recommended action on the part of the group in the best interests of all in the market. It is essential, he remarked, for fuel oil dealers to be included if the picture is to be made complete.

New officers elected were: president, Reginald Swett, Delco Sales and Service; vice-president, F. J. Kasper, Murphy & Potter, Inc.; treasurer, G. M. Ridgway, Leader Engineering Co.; clerk, John Williams, Petroleum Engineering Corp.; and temporary clerk, R. E. Cross, Minneapolis-Honeywell Co.

Carrier Moves to Syracuse

SYRACUSE, N. Y. — The former Franklin plant, of a million and one-quarter square feet, taken over recently for taxes by the City of Syracuse, was bid in at auction here recently for Carrier Corp. by L. R. Boulware, vice-president and general manager. It is expected that 80% of the administrative and productive operations of the air conditioning Company will be shifted to Syracuse within one year.

Mr. Boulware made the bid as a result of six months' effort to get the Carrier operations to Syracuse, during which time the Chamber of Commerce collected from local business men a fund of $250,000 for Carrier to apply to moving expenses and improvements in the plant.

Theater Circuits Sign Agreement on Auditorium Patents

BOSTON — Warner Brothers Pictures, Inc., Loew's Inc., and National Theaters Corporation, have signed agreements with Auditorium Conditioning Corp., ending a period of litigation and uncertainty concerning the "Auditorium Bypass patents" and more than a score of others covering various systems of air conditioning for human comfort.

The Lewis Reissue Patent No. 16,611 and Fleisher Patent No. 1,670,656 (now reissued as Re. 20,088), known as the "bypass patents," have been in the courts for about ten years. They were twice upheld in litigation involving theater air conditioning systems, but in a third suit against Warner Brothers Pictures, Inc., the District Court held the claims sued upon to be invalid and this was affirmed by the Circuit Court of Appeals. Auditorium Conditioning Corp. disputed this adverse decision and immediately filed another suit against a Loew controlled theater in order to get a decision by the U. S. Supreme Court. This suit is now terminated under the agreements recently signed.

Under the terms of the contracts, the theater circuits obtain a license for all their existing air conditioning systems under all patents owned by Auditorium Conditioning Corp., including the "bypass patents"; and agree that whenever any patents of Auditorium Conditioning Corp. are used, that the contractor making the installation, extension or reconstruction embodying said patents shall pay to Auditorium the currently established royalty rate.

Furnace Makers Sponsor Warm Air A.C. Week

CHICAGO — Leading manufacturers of furnaces, furnace supplies and air conditioning units are again sponsoring a national movement to bring warm air heating and air conditioning before the public eye, and have designated August 22-28 as National Warm Air Heating and Air Conditioning Week. During this week, over 15,000 warm air heating and air conditioning dealers throughout the United States will display late models of modern warm air heating and air conditioning equipment, and will have special offers to attract those interested in air conditioning and warm air heating.

Home Building Tops Population Gain in 1936

MINNEAPOLIS — For the first time in six years, new homes built in 310 leading American cities in 1936 exceeded the requirements of estimated population increase in those cities, E. E. Crabb, executive vice-president of Investors Syndicate, of this city revealed recently. The cities included in the survey contain more than one-third of the country's population, Mr. Crabb said.

"Residential construction in these 310 cities last year provided housing for 491,608 people, or for 1.29% more than the 483,757 estimated population gain in this group of cities during 1936," said Mr. Crabb, in commenting on the survey. "These 310 cities, located in 41 states and the District of Columbia, constitute an accurate index to the national home building situation.

"However, a substantial housing deficit continues to exist in these cities, because for the six-year period, 1931 to 1936 inclusive, new residential construction was sufficient to take care of only 1,453,792 people, or 62.33% of the estimated population gain of 2,332,441. There must also be taken into account a further shortage created by destruction of homes by fire, flood, and normal rate of obsolescence."

British Study Toxic Gases in Industry

LONDON—The British Department of Scientific and Industrial Research is publishing a series of booklets describing standard methods for the detection of toxic gases in industry. The first of the series, just issued, deals with hydrogen sulphide.

It is pointed out that in concentrations of one part in 1000 by volume this gas is nearly as poisonous as prussic acid and can kill almost as quickly. In concentrations of one part in 10,000 it gives symptoms of irritation in the eyes and throat after one hour's exposure to the fumes.

This gas has widespread occurrence in industry. In addition to its formation during the decomposition of all organic matter containing sulphur, it is encountered in many important industries. Sense of smell, it is pointed out, is not always a guide to safety. In all factories where this gas is given off an efficient system of mechanical ventilation or air purification is essential.

A.C. School Opens in Los Angeles

LOS ANGELES—A new air conditioning and refrigeration training school, the Thermo Air Conditioning Institute, Inc., opened its doors recently and first classes are now being held. The school is headed by Dr. F. G. Baender, and includes on its advisory board a number of well-known figures in the industry.

The school occupies its own building at 186 S. Alvarado St., and is air conditioned throughout.

Doctor Baender has long been associated with the teaching of air conditioning, heating and ventilating, refrigeration, and related subjects. He has headed the departments of mechanical engineering at Oregon State College and the University of Arkansas; held professorial chairs at the Universities of Iowa and Missouri and Cornell University; and served variously as consulting, research, and designing engineer with a number of private companies.

Courses combine a study of the theory and principles of air conditioning and refrigeration and practical training in the shops of the Institute.

L.&N. Conditions Coaches

BIRMINGHAM—The Louisville & Nashville Railroad has air conditioned 61 of 80 coaches, with 19 more under way.

When the program planned last fall is completed the company will have 119 coaches and 16 diners air conditioned, which will provide equipment of this kind for all passenger trains on its system except a few locals. The other 55 of an earlier program were completed last year.

The cost of air conditioning the coaches and diners exceeds $1 million, with the present program of 80 coaches costing more than $800,000.

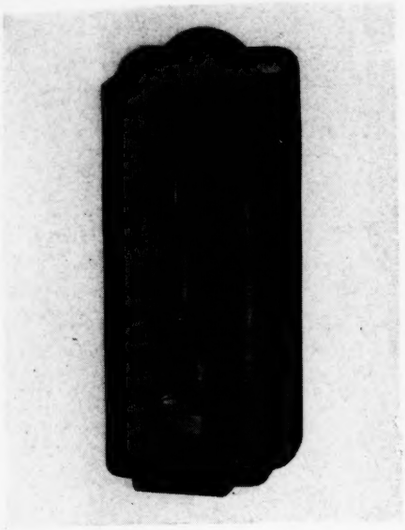
1175 Tons of A.C. for Chicago

CHICAGO—Air conditioning installations added during May to the lines of the Commonwealth Edison Co. totaled 1175½ tons. The largest single installations were two 100-ton jobs, one in an office, another in an industrial plant.

Edwin P. Crawe

BOSTON—Edwin P. Crawe, president and treasurer of Waverley Heating Supply Co., died Sunday, July 13, at his home in Newtonville, Mass., at the age of 62. He was born in Watertown, N. Y., and came to Boston in 1903, when he started with William L. Healy to build up the firm which he headed.

NEW EQUIPMENT



Minneapolis-Honeywell Da-Nite Acratherm

NAME—Minneapolis-Honeywell Da-Nite Acratherm.

PURPOSE—A thermostat and time control for automatically resetting manually lowered night temperatures.

FEATURES — This instrument combines the Acratherm and Time-O-Stat into one instrument. It is equipped with a black setting dial and winding knob for adjustment. The temperature setting can be made at any point as low as 45F by moving the indicator to the desired lower temperature scale. A dial lock screw is furnished to prevent tampering with the temperature setting. Thermometer is recessed to guard against breakage. Instrument is furnished with a detachable wall plate for mounting. The day scale range is from 55 to 85F and the night scale range from 45 to 75F.

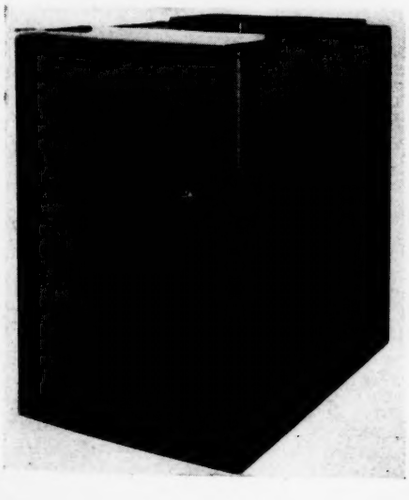
MADE BY—*Minneapolis-Honeywell Regulator Co., 2715 Fourth Ave., S., Minneapolis, Minn.*

Bryant Winter Air Conditioner

NAME AND MODEL NUMBER—Winter air conditioner, model AC-78.

PURPOSE—For heating, cleaning, circulating, and humidifying air.

FEATURES—The entire heating unit is built of cast iron and is enclosed in a special inner cabinet. Filtered air passes through this cabinet under pressure and is heated and humidified before it is circulated through the house. The space between the inner and outer casing is under a vacuum. This is said to result in a higher heating efficiency and low heat radiation loss to the basement. A special flue economizer is used to increase the efficiency. Filters are used for cleaning. Air is circulated by means of a centrifugal blower.



SIZES—Made in six sizes with input ranging from 100,000 to 364,000 B.t.u. per hr.

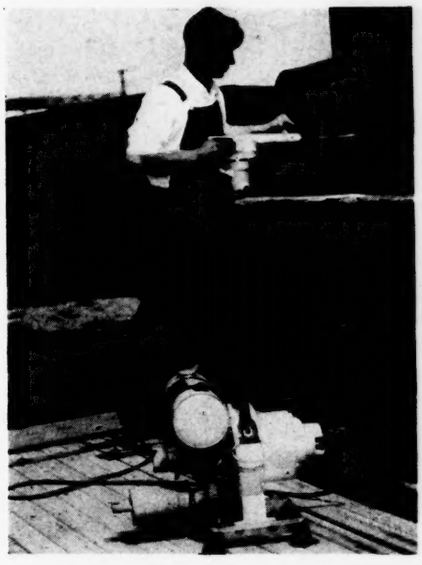
MADE BY—*The Bryant Heater Co., Cleveland, Ohio.*

Black & Decker Electric Hammer

NAME—Black & Decker portable electric hammer No. 34.

PURPOSE—A portable electric hammer operated by a portable gasoline driven electric generator.

FEATURES—The special design of these motors is said to permit their use on a portable electric generator as well as on the large central station supply lines. It is said that the motor delivers the same power to the tool regardless of the source of supply. The photograph shows the hammer being used with a portable gasoline driven electric generator as made by the Homelite Corp., Port Chester, N. Y.



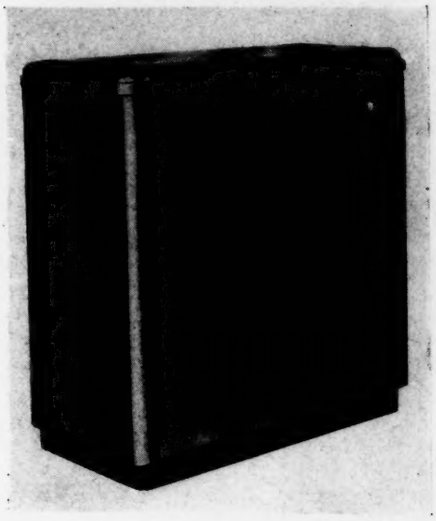
MADE BY—*The Black & Decker Mfg. Co., Towson, Md.*

G-E Room Air Conditioner

NAME AND MODEL NUMBER—Self-contained room conditioner, type AF-1.

PURPOSE—For summer room conditioning.

FEATURES—Unit is semi-portable and has a cooling capacity of about two-thirds of a ton. No drain or water connections are required. Unit is mounted next to a window and uses outside air to cool the refrigerant in the condenser. The hot air from the surface of the condenser absorbs the moisture condensed by the cooling coils and is discharged through the window. A drip pan covers the entire bottom of the unit. Forced ventilation of the air in the motor compressor compartment prevents heat and odors thrown off by the compressor and motor from entering the room. It is said that the operating cost of the unit is about 4c per hr. It is possible to increase the cooling capacity of the unit to about one ton by supplying a small amount of water through a small water line and making minor changes in the mechanism. This water is pumped over the condenser and cools the condenser by evaporation. A drain connection is not needed. The unit is enclosed in a burled walnut cabinet with slotted moldings. All controls are concealed.



SIZE—Approximately 41 in. long, 19 in. wide, and 44½ in. high; weight about 550 lb.

MADE BY—*General Electric Co., Air Conditioning Dept., Bloomfield, N. J.*

Mercoid Sensatherm

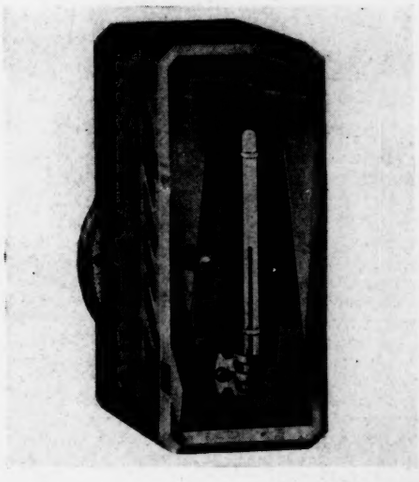
NAME—Mercoid Day-Night Sensatherm.

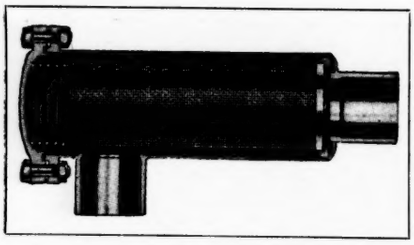
PURPOSE—A day and night thermostat.

FEATURES—This instrument combines in one unit the well known Mercoid standard Sensatherm with a specially designed hand-wound timer mechanism. The timing mechanism can be set for any period up to a 9-hr. interval. A calibrated dial on the side indicates the time interval for which the instrument is set. It is said that the Sensatherm will hold the temperature to within a total differential of 1F of any predetermined setting. The standard range is 55 to 85F.

LITERATURE AVAILABLE—Bulletin D-16.

MADE BY — *The Mercoid Corp., 4201 Belmont Ave., Chicago.*





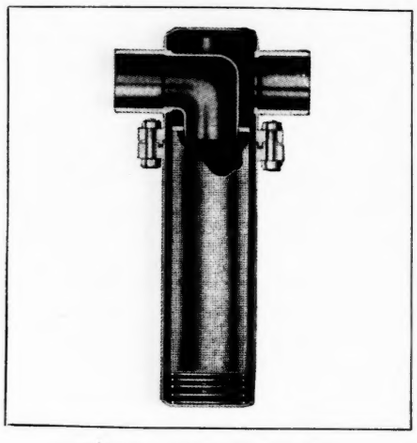
Type 866 refrigerant strainer.

Henry Refrigerant Strainers

NAME AND MODEL NUMBER—Henry refrigerant strainers, types 866 and 877.

PURPOSE—For removing grit and impurities from refrigerants.

FEATURES — Type 866 is an angle type strainer while type 877 is of the horizontal type. Both models can be cleaned without removing the strainer from the line. The spring tension provides a seal of screen against the inlet fitting. It is said that the angle type will not trap oil, while with the horizontal type oil trap can be minimized by installing the strainer on its side and keeping the inlet and outlet in a horizontal plane, or entirely prevented by installing the strainer so that the outlet is pointing upward or downward.



Type 877 refrigerant strainer.

Strainers are furnished with 100 mesh monel screen for liquid line, or 50 mesh monel screen for suction line. Both strainers are designed for use with copper pipe and the shell is built of flanged brass.

SIZES—Angle type, eight sizes from 5/8 to 2 5/8 O. D. size; horizontal type, five sizes from 5/8 to 1 3/8 O. D. size fitting.

LITERATURE AVAILABLE—Catalog 62.

MADE BY — *Henry Valve Co., 1001-19 N. Spaulding Ave., Chicago.*

Sampsel Synchronizing Control

NAME—Sampsel synchronizing control.

PURPOSE—For controlling operation of warm air conditioning systems in both summer and winter. Also, for controlling stoker-fired, hot water plants which use a circulating pump.

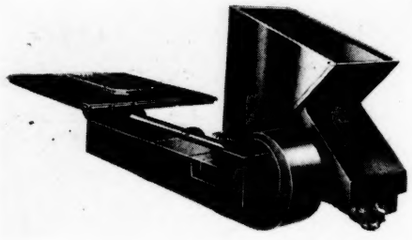
FEATURES—On a warm air system a call for heat from the thermostat starts the stoker and also the blower. Both will continue to run until the thermostat is satisfied unless the temperature in the bonnet of the furnace builds up to the extent that the bonnet-switch cuts off. In this case the stoker will be stopped but the blower will continue to operate until the thermostat is served. Each control contains a standard fire pilot control for maintaining a continuous fire in mild weather. For summer operation the control may be used for cooling. The thermostat is set at the desired summer temperature and when the room temperature reaches this setting, the blower will start and continue to run until the room temperature falls below the setting. When this control is used with hot water plants, the circulating pump functions in the same manner as the blower on warm air systems.

MADE BY—*Sampsel Time Control Inc., Mendota, Ill.*

Winkler Commercial Stoker

NAME AND MODEL NUMBER — Winkler Commercial stokers, models 18, 30, 55 and 75.

PURPOSE—For automatic combustion of bituminous coal.



FEATURES—An inter-plan drive which is an internal planetary gearing of the continuous speed type. This drive is said to be silent and has three speeds which are easily changed. Drive belt is adjusted automatically. The fan is direct driven by an electric motor. A locked screw safety release is used to automatically disconnect the transmission from the screw to prevent any damage when an obstruction is in the screw. A relay automatically reconnects the transmission and screw when the obstruction is removed. A light or ringing bell is used to give notice of the locked screw. An automatic air volume regulator controls the air volume by holding the velocity in the air tube at a predetermined value.

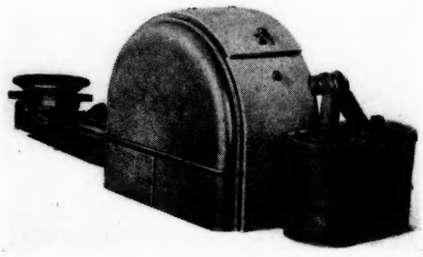
SIZES AND CAPACITIES—Burning capacity ranges from 180 to 825 lb. of coal per hour.

MADE BY — *Winkler Manufacturing Corp., Lebanon, Ind.*

Fairbanks-Morse Anthracite Burner

NAME AND MODEL NUMBER—Fairbanks-Morse anthracite coal burner, model KAR.

PURPOSE—For automatic burning of anthracite coal.



FEATURES — Stoker has a control which automatically regulates the amount of air needed for maximum heat reduction. A spike catcher is located at the juncture of the conveyor tube and the hopper base to prevent any obstructions from reaching the conveyor tubes. This catcher is easily accessible. The retort is designed to provide a fuel bed of the correct shape and thickness for maximum efficiency. It revolves slowly while the stoker is in operation so as to maintain a fuel bed that is spread evenly throughout the firepot. It is said that this eliminates fire cracks and blow holes.

MADE BY—*Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago.*

Detroit Adjustable Stoker Feed

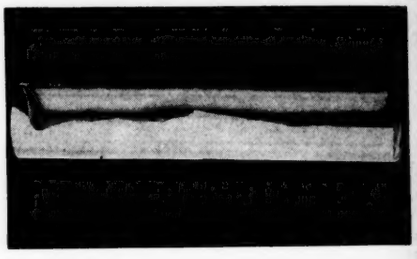
NAME—Detroit adjustable stoker feed.

PURPOSE—For controlling the stoker fuel feed to the furnace over a range from zero to maximum capacity.

FEATURES—The adjustable feed is built into the right-hand crankshaft bracket of the Detroit single retort and Detroit UniStokers. It may be applied to existing installations when desired. It may be either manually or automatically operated. If automatically operated, the master regulator which is connected to the Detroit Adjustable Feed may also be connected to the damper at the fan inlet or outlet, so that the air supply is synchronized with the fuel feed, as required by changes in load on the boiler, as indicated by steam pressure variations. The master regulator may also be connected to the boiler uptake damper if desired.

AVAILABLE ON—New or existing Detroit single retort and UniStokers.

MADE BY—*Detroit Stoker Co., Detroit.*



Victor Copper Tanks

NAME—Victor seamless copper tank.

PURPOSE—Tanks for withstanding pressures from 85 to 150 lb.

FEATURES — These tanks are made by a process of electrical deposition. Each tank is one homogeneous piece of copper which is said to be uniform in thickness. The outlets are reinforced with hard copper "spuds" which are said to become an integral part of the tank during its formation by electrical deposition from electrolytically pure copper. All tanks are tested up to 300 lb. pressure under Massachusetts regulations.

SIZES—Made in a full line of sizes, extra heavy and double-extra heavy types for working pressures from 85 to 150 lb.

MADE BY—*Victor Mauck Seamless Copper Tank Co., Norristown, Pa.*

Ruby Steel Soldering Flux

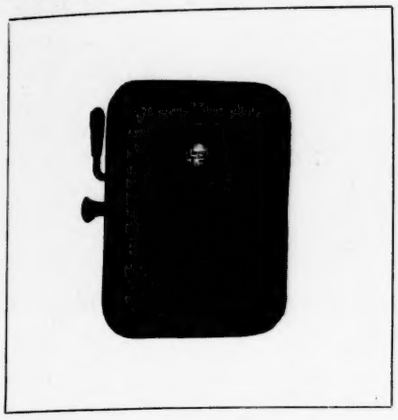
NAME — Rubyfluid stainless steel soldering flux.

PURPOSE—A flux to make possible the soldering of stainless steel.

FEATURES—It is said that when this flux is used no special soldering equipment or solder is needed, that the flux will not give off strong odors and will not burn when contacting the hands.

QUANTITIES AVAILABLE — Pints, quarts, gallons.

MADE BY—*The Ruby Chemical Co., 68-70 McDowell St., Columbus, Ohio.*



Sampsel Time Control

NAME—Fire pilot control.

PURPOSE—For controlling the operation of stokers.

FEATURES—Control can be set to provide hour, half-hour or 15-min. intervals. The duration of contact can be adjusted from 30 sec. minimum to 28 min. maximum. An indicator dial, which travels in the same direction of rotation as the second hand on a watch, indicates the proper functioning of the control. A heavy duty transformer is provided to hold the low voltage side constant regardless of fluctuations upon the lines. A fused knife blade type service switch is provided so as to eliminate the necessity of installing an additional entrance switch for stoker connections. All working parts are concealed in a bakelite housing.

MADE BY—*Sampsel Time Control Inc., Mendota, Ill.*

Armstrong-Corning Glass Insulation

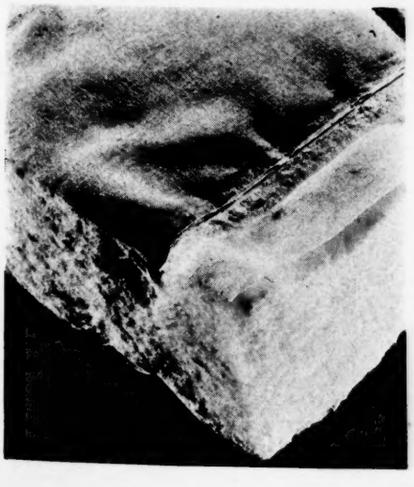
NAME—Armstrong-Corning wool.

PURPOSE—A stitched blanket insulation of fibrous glass for hot water heaters and other equipment where the requirements are not severe.

FEATURES—The material is bats of Armstrong-Corning wool stitched between two layers of Kraft paper. It is said that this insulation is made from carefully selected inorganic materials and is fireproof, does not absorb moisture or fumes, is resistant to acids, and does not deteriorate.

SIZES AND TYPES—Available in three thicknesses, 1, 1½, and 2 in. and in three densities, also in sizes up to 9 by 50 ft.

MADE BY—*Armstrong Cork Co., Lancaster, Pa.*



Central Air Conditioners

NAME—All-year-air unit.

PURPOSE—For providing the functions of winter air conditioning, including tempering, humidifying, filtering, deodorizing, activating and circulating. The summer unit circulates cool night air for absorbing and removing the accumulated heat in the building.

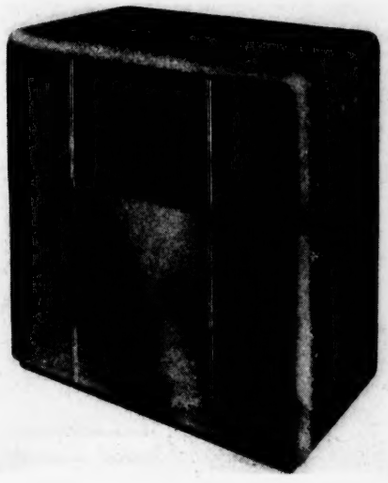
FEATURES—The deodorizing and activating are obtained by a compact ozone generator which is said to destroy odors by oxidation and an ionizer for electrically activating negative ions in the recirculated indoor air. Unit may be operated automatically or manually and is designed for installation in the basement in conjunction with the warm air heating plant. Models are also available for use with hot water or steam heating plants.

MADE BY—*Central Mfg. Div., Auburn Automobile Co., Connersville, Ind.*

Herman Nelson Cooling Unit

NAME—Self-contained cooling unit.

PURPOSE—For comfort cooling in residences and offices.



FEATURES—Unit consists of a reciprocating compressor, water-cooled condenser, evaporator, fan and motor, all automatically controlled and housed in a compact, insulated cabinet. Two control knobs are located on the side of the cabinet, one knob controls the operation of the fan while the other provides an adjustment of the automatic thermostat for the degree of cooling desired. Cabinet is constructed of heavy gage furniture steel and is finished in an iridescent light tan baked enamel with a stainless steel trim. Unit can be located anywhere in the room. Requires electrical and water connections.

SIZES AND CAPACITIES—Manufactured in one size to provide ¾-ton cooling capacity with sensible heat rating of 6400 B.t.u. per hr. and a total rating of 9000 B.t.u. per hr. Air circulation is 360 c.f.m.

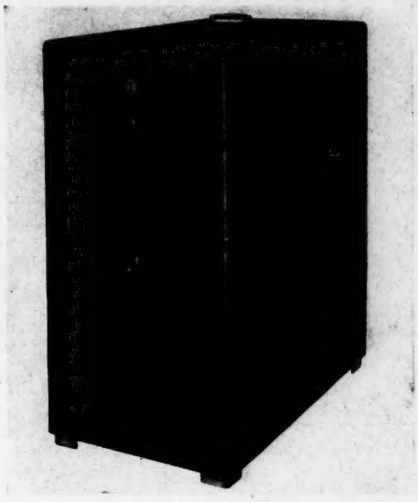
MADE BY—*Herman Nelson Corp., Moline, Ill.*

Bryant Gas Boiler

NAME AND MODEL NUMBER — Bryant boiler, No. 25.

PURPOSE—For steam and vapor heating utilizing gas as a fuel.

FEATURES—Special heating sections which are said to produce a high heat exchange efficiency are used. All of the controls are completely enclosed by a cabinet which also encloses all valves and piping. All exposed bolt and screw heads are eliminated by lock-seam joints. It is said that the entire cabinet can be assembled or removed in a few minutes. Controls consist of a combination steam pressure governor and low water cutoff, combination thermostatic pilot and air burner, throttling control valve, safety valve, pressure regulator, and a pressure and vacuum gage.



SIZES AND CAPACITIES—Six sizes ranging from 145 to 385 sq. ft. of direct cast iron radiator surface.

MADE BY—*The Bryant Heater Co., Cleveland, Ohio.*

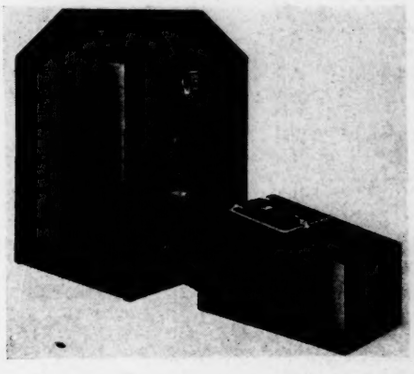
Anchor Furnace Stoker Unit

NAME—Anchor Kolstoker heating system.

PURPOSE — For supplying warm air using stoker-fed coal.

FEATURES—Both the stoker and furnace are said to be designed to function together with maximum efficiency. It is said that the heating system will deliver full heating efficiency at all times because of a self-cleaning radiator. Extra heavy cast iron construction and asbestos linings are used. The firebowl sections are almost 1 in. thick and heavily webbed. Deep grooved joints and wide bearing surfaces are provided between the sections to prevent leaks. The design offers eight radiator connections and four smokepipe positions. Furnace has a removable plate for the installation of a fan and filter unit. A special coil is available for hot water in warm weather. Shifting the position of a reversible lower section permits the stoker installation from either side or front. The stoker is equipped with a sectional burner head and a complete automatic control of coal feed and temperature. It is enclosed in a soundproof cabinet finished in black and red.

MADE BY—*Anchor Stove & Range Co., New Albany, Ind.*



Summer Degree-Hours—An Estimating Unit for Summer Air Conditioning

Continuing a new monthly service in HEATING & VENTILATING covering summer temperatures in 31 cities

THERE is a fair amount of evidence that that part of the cooling load in air conditioning which depends on the outdoor dry bulb temperature is proportional to the number of hours the temperature is above 85F. The calculation of the number of these degree-hours in the summer depends on the availability of hourly dry bulb temperature readings and for that reason data can not be prepared for all cities. However, the table below gives the number of degree-hours for June and cumulative total to June 30 for 31 cities.

The degree-hour unit is similar to the degree-day unit used for winter estimating, differing however in one important respect—the number of degree-days in a given month in a given city usually compares within ± 20% of the number for the same month in other years; this is not the case with degree-hours which fluctuate all the way from zero to over 800 in the same month in different years. Consequently, the unit does not lend itself to predicting as does the degree-day unit. However it does enable one to make comparisons of a part of the sensible heat load, with the temperature variable eliminated.

Summer Degree-Hours (Above 85F), June, 1937

June, 1937	June, 1936	City	Year, 1937, to June 30	Year, 1936, to June 30
197	191	Baltimore	258	319
951	1596	Birmingham	1258	1694
206	537	Bismarck	249	645
51	0	Boston	99	47
7	10	Buffalo	7	10
128	93	Chicago	173	135
121	601	Cincinnati	227	677
0	26	Cleveland	7	27
48	325	Columbus	100	450
413	574	Des Moines	427	651
1	11	Detroit	36	59
5	111	Fort Wayne	38	122
38	21	Grand Rapids	89	35
936	1193	Houston	1099	1236
44	331	Indianapolis	126	361
874	1910	Kansas City	939	2041
532	1406	Memphis	756	1486
80	37	Milwaukee	92	43
113	97	Minneapolis	133	139
622	1204	New Orleans	820	1242
21	2	New York	30	25
66	80	Philadelphia	88	211
49	109	Pittsburgh	67	135
83	0	Portland, Oreg.	83	30
261	353	Richmond, Va.	365	520
431	1121	St. Louis	568	1202
699	608	Savannah	933	777
0	0	San Diego	0	0
1	0	San Francisco	1	0
2	71	Toledo	38	106
142	218	Washington	211	336

Degree-Day Figures for June, 1937

and Totals for Season of 1936-37 for 63 Cities

HEATING & VENTILATING concludes its ninth year of publishing degree-day data for various large cities.

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for June, 1937.....	5	0	0	0	35	50	46
Deg.-days, season 1936-37, Sept. to June	5188	2727	4141	2367	5700	6621	7521
Deg.-days, season 1935-36, Sept. to June	6540	3279	4741	2926	6142	7350	8003
Deg.-days, Sept. to June incl., Normal..	6889	2890	4533	2352	6045	6822	7620

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for June, 1937.....	222	71	8	24	7	140	26
Deg.-days, season 1936-37, Sept. to June	7888	6353	4976	5753	5246	6266	6738
Deg.-days, season 1935-36, Sept. to June	7480	6967	5600	6458	5991	5772	7297
Deg.-days, Sept. to June incl., Normal..	7462	6290	4703	6155	5323	5874	6384

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for June, 1937.....	37	29	164	0	23	1	29
Deg.-days, season 1936-37, Sept. to June	6505	4158	9916	2755	6014	4381	6129
Deg.-days, season 1935-36, Sept. to June	7072	5279	10556	2338	6718	4944	6811
Deg.-days, Sept. to June incl., Normal..	6490	5034	9480	2428	5866	4164	5934

	Grand Rapids, Mich.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Kansas City, Mo.	La Crosse, Wis.	Lincoln, Neb.
Degree-days for June, 1937.....	48	0	6	17	16	52	33
Deg.-days, season 1936-37, Sept. to June	6523	5176	5650	5454	5272	7766	6380
Deg.-days, season 1935-36, Sept. to June	7074	5661	6033	6117	5622	8191	6816
Deg.-days, Sept. to June incl., Normal..	6535	5375	6036	5298	4852	7322	5999

	Little Rock, Ark.	Los Angeles, Calif.	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.
Degree-days for June, 1937.....	0	8	3	65	0	103	74
Deg.-days, season 1936-37, Sept. to June	3206	1475	4449	7616	3199	7075	8390
Deg.-days, season 1935-36, Sept. to June	3510	1150	4996	8073	3654	7634	9020
Deg.-days, Sept. to June incl., Normal..	2811	1504	4180	7395	2950	7245	7850

	Nashville, Tenn.	New Haven, Conn.	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma, City, Okla.	Omaha, Neb.
Degree-days for June, 1937.....	0	8	0	5	0	0	27
Deg.-days, season 1936-37, Sept. to June	3531	5405	1087	4857	3068	3990	6772
Deg.-days, season 1935-36, Sept. to June	4108	5883	1401	5373	3652	3931	7237
Deg.-days, Sept. to June incl., Normal..	3578	5895	1024	5347	3349	3613	6131

	Peoria, Ill.	Philadelphia, Pa.	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.
Degree-days for June, 1937.....	23	2	1	78	63	21	1
Deg.-days, season 1936-37, Sept. to June	6025	4541	5019	6640	4479	5540	4949
Deg.-days, season 1935-36, Sept. to June	6723	4997	5735	7042	4435	6004	5484
Deg.-days, Sept. to June incl., Normal..	6109	4855	5235	7012	4469	6014	5389

	Richmond, Va.	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.
Degree-days for June, 1937.....	0	23	6	67	124	3	89
Deg.-days, season 1936-37, Sept. to June	3678	6342	4774	6013	2926	5903	4672
Deg.-days, season 1935-36, Sept. to June	4248	6975	5340	5498	2318	6397	4506
Deg.-days, Sept. to June incl., Normal..	3725	6732	4585	5555	2876	6129	4883

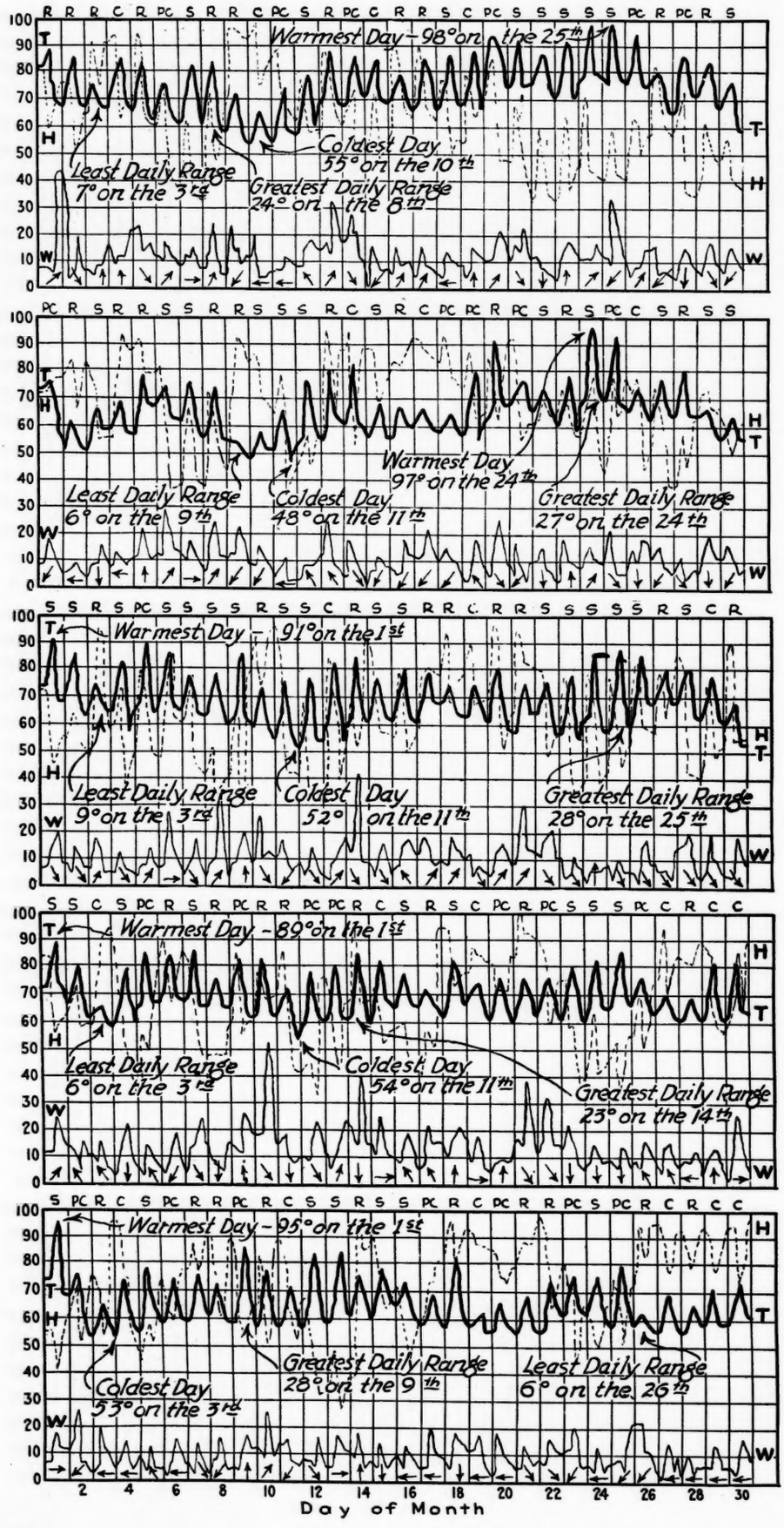
	Spokane, Wash.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.†	Washington, D. C.	Wichita, Kan.
Degree-days for June, 1937.....	115	21	30	7	—	0	11
Deg.-days, season 1936-37, Sept. to June	6898	6246	6152	4966	6537	4207	4997
Deg.-days, season 1935-36, Sept. to June	6505	6888	6831	5505	7006	4753	5040
Deg.-days, Sept. to June incl., Normal..	6355	6893	6103	4933	6796	4626	4673

To obtain unit fuel consumption figures for any city shown above, multiply the number of degree-days by the following factors: for coal, 0.008; for oil, 0.00069; for gas, 0.096. Figures obtained will show coal consumption in pounds per square foot of radiator surface; oil consumption in gallons per square foot; gas consumption in cubic feet per square foot—all for the period covered by the number of degree-days. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operation at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal; 140,000 B.t.u. per gal. for oil, and 1,000 B.t.u. per cu. ft. for gas. To correct for other heating values, efficiency and design conditions, follow the method explained in the "HEATING & VENTILATING Degree-day Handbook" or on H. & V.'s Reference Data Sheet Nos. 67 and 68. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

†June figure not available. Seasonal totals do not include June.

THE WEATHER FOR JUNE, 1937

Plotted from records compiled for HEATING & VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.


Warmest Day - 98° on the 25th
Coldest Day 55° on the 10th
Least Daily Range 7° on the 3rd
Greatest Daily Range 24° on the 8th
Warmest Day 97° on the 24th
Least Daily Range 6° on the 9th
Coldest Day 48° on the 11th
Greatest Daily Range 27° on the 24th
Warmest Day - 91° on the 1st
Least Daily Range 9° on the 3rd
Coldest Day 52° on the 11th
Greatest Daily Range 28° on the 25th
Warmest Day - 89° on the 1st
Least Daily Range 6° on the 3rd
Coldest Day 54° on the 11th
Greatest Daily Range 23° on the 14th
Warmest Day - 95° on the 1st
Coldest Day 53° on the 3rd
Greatest Daily Range 28° on the 9th
Least Daily Range 6° on the 26th
Day of Month

St. Louis

Mean temp. for month, 75.4F; aver. wind velocity, 10.2 m.p.h.; prevailing direction of wind, SW.

Chicago

Mean temp. for Month, 65.9F; aver. wind velocity, 9.7 m.p.h.; prevailing direction of wind, NE.

Pittsburgh

Mean temp. for month, 70.2F; aver. wind velocity, 9.2 m.p.h.; prevailing direction of wind, NW.

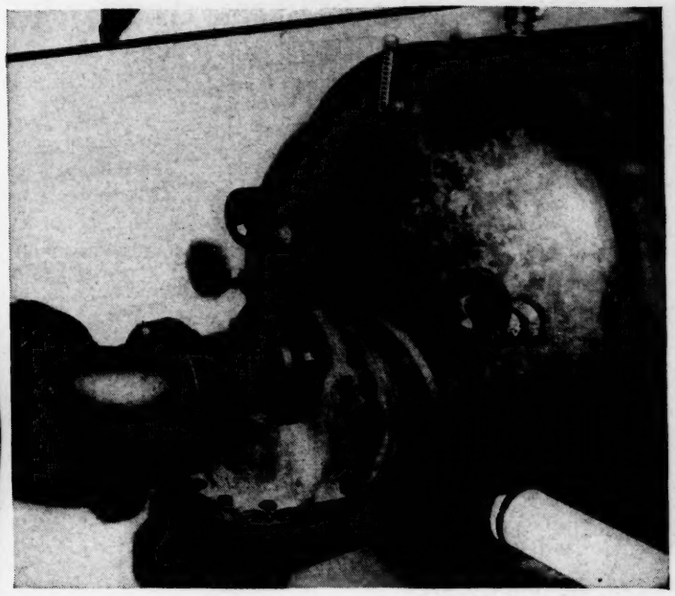
New York

Mean temp. for month, 70.6F; aver. wind velocity, 11.2 m.p.h.; prevailing direction of wind, N.

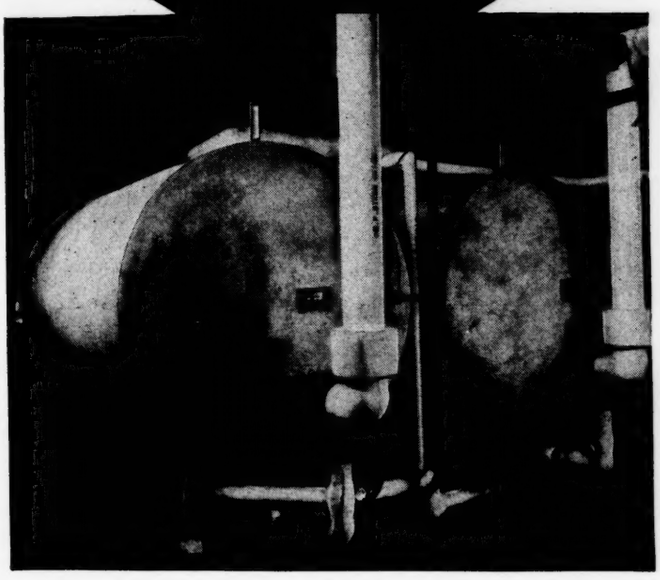
Boston

Mean temp. for month, 66.4F; aver. wind velocity, 8.6 m.p.h.; prevailing direction of wind, E.

Rustless... strong... easily welded... no wonder the choice is EVERDUR Silicon Bronze



Club ... For an exclusive club in upper Manhattan, this Patterson-Kelley solid EVERDUR "Lo-Flo" hot water service and storage heater assures a constant supply of rust-free hot water. Size 42" x 168". Storage capacity 1,000 gallons. Heating capacity 1,750 gallons per hour. This heater was brought into the building in eight pieces, and electrically butt welded on the job by the Patterson-Kelley Co.



Institution ... At the New York City Penitentiary laundry on Riker's Island, these two Patterson-Kelley solid EVERDUR storage heaters provide rust-free hot water and permanent freedom from repair expense due to rust. Each is 60" x 120" and of 1,400 gallons capacity. Heating capacity 2,000 gallons per hour. Sloan & Robertson, New York City, Architects. Clark, MacMullen & Riley, Consulting Engineers. C. H. Cronin, Inc., Plumbing Contractor.

MORE and more property owners are discovering the economy of non-rust EVERDUR Metal for hot water storage heaters. Thus, instead of rust-discolored water from tanks of limited life, they obtain an enduring supply of rust-free hot water. They can forget about the possibility of repairs or replacements due to rust!

EVERDUR is "in a class by itself" for durable heaters because it is rustless as copper, strong as steel, and easily welded. Furnished in all commercial shapes, including tank plates which conform to all requirements of A.S.T.M. Specification B96-36T. Obtainable from leading equipment manufacturers.

ANACONDA

37167

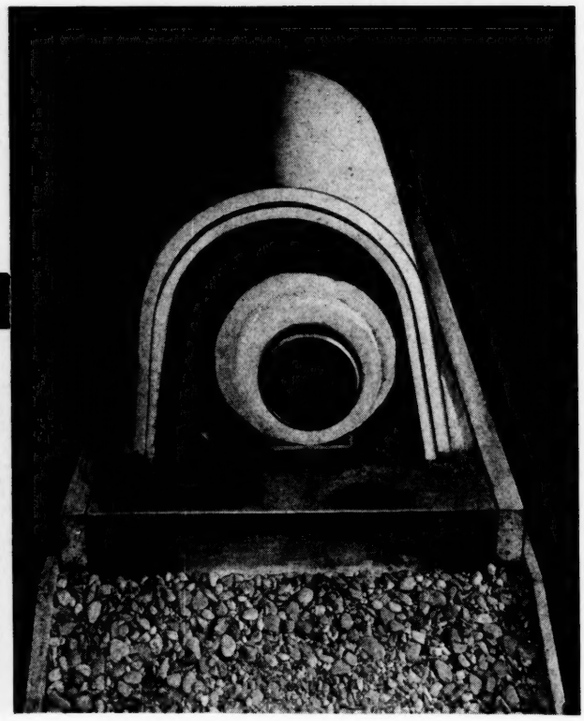
Everdur Metal

RUSTLESS AS COPPER
STRONG AS STEEL

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

EVERDUR is a trade-mark of The American Brass Company, registered in the United States Patent Office.



AIR-STONE CONDUIT

for Underground Steam Lines

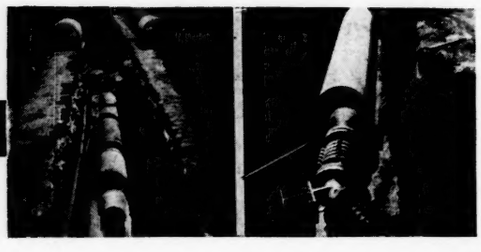
Simplified construction—reduced cost—increased efficiency with the NEW PRECAST VIBRATED CONCRETE CONDUIT. Investigate "the Dockstader Way" for better installation of underground steam mains.

S. E. DOCKSTADER

305 Munsey Building, Washington, D. C.

Below Left: Air-Stone Conduit installation in St. Louis. Utility Company supplies high pressure steam to new Post Office in downtown section.

Below Right: Air-Stone Conduit construction on steam line from power plant of U. S. Capitol in Washington, D. C.



(Abstracts concluded from page 66)

Oil Burners

The author's purpose in preparing this book is to present a complete treatise on oil burning practice, embracing both the fundamental and advanced engineering as well as the practical methods of oil burner design, construction, installation, operation and maintenance. The general plan of the text is first to state the fundamental principles from which the subject matter of the chapter is to be built up, and then to proceed rapidly through theoretical material to the pertinent conclusions. It is the author's purpose to steer a middle course between the elementary treatment and a highly technical one and the book describes basic concepts and essential engineering as well as actual practice. While the author has presented the material in a manner suited to an engineering text, he has also attempted to make the book as practical as possible.

A list of the chapter headings follows: Hydro-carbons and Petroleum; Fuel Oil; Combustion of Fuel Oil; Comparative Fuel Data; Problems of Oil-Burner Design; Domestic Oil Burners; Commercial Oil Burners; Industrial Oil Burners; Fans and Electric Motors; Electric Controls; Ignition Methods; Fuel-Oil Pumps and Pumping; Oil Piping, Strainers and Flow Regulators; Combustion Chambers for Heating Plants; Industrial Boiler-Plant Installations; Preheating Fuel Oil; Oil Storage Tanks and Gauges; Service and Maintenance of Domestic and Commercial Oil Burners; Shell-Type Vaporizing Burner; Control of the System.

[*"Oil Burners," by Kalman Steiner. Published by McGraw-Hill Book Co., New York; cloth bound; 6 x 9 in.; 436 pages; price, $4.50.*]

BRIEF REVIEWS

SPANISH FAN DATA. A Spanish translation of "Centrifugal Fans, Standard Method of Designating Discharge, Rotation and Arrangement for Drive." This publication is part of a campaign to assist American machinery builders in obtaining their share of the Latin American market. [*"Ventiladores Centrifugos," published by the Machinery Div. of the Bureau of Foreign and Domestic Commerce, Washington, D. C.*]

DEEP WELL PUMPS. A booklet giving the standards of the Hydraulic Institute on deep well turbine pumps. Included are definitions, methods of field testing, general information on installation and operation, friction losses in deep well columns, power balance in deep well turbine pumps, and air line method of determining the depth of water level. [*"Standards of Hydraulic Institute—Deep Well Turbine Pump Section," published by the Hydraulic Institute, 90 West St., New York. Paper cover; 21 pages; 8½ x 11 in.; price, 25c.*]

FAIR FAN COMPARISON CHART. A revised bulletin of the fair fan comparison chart of commercial ventilating sizes, incorporating minimum recommended standards of gages of steel for fan housings. [*"Fair Comparison Chart," published by the National Association of Fan Manufacturers, 5-208 General Motors Bldg., Detroit, Mich. 8½ x 11 in., 4 pages.*]

WITH THE MANUFACTURERS

Armstrong Cork Co., Lancaster, Pa., has appointed *George W. Kittridge* assistant manager of the personnel department, assisting *John J. Evans, Jr.*, recently appointed manager of the department. *Oscar G. Wheat* succeeds Mr. Kittridge as assistant general superintendent at the company's factory at Beaver Falls, Pa. Mr. Wheat's successor as assistant general superintendent at the South Braintree, Mass., plant will be *H. G. Jones*.

Barber Gas Burner Co., Detroit, Mich., has elected *Harry M. Mansfield* president. Mr. Mansfield was formerly secretary of the company. Associated with the company for 11 years, Mr. Mansfield succeeds to the office made vacant by the death of Harry E. Kerr.

Carrier Corp., Newark, N. J., has expanded its design and application engineering force. *George T. Long* will have charge of the residential air conditioning department, and *Stanley Ellison* and *Donald Flynn* have been added to the commercial refrigeration staff; *E. L. Hinchliff*, public utilities; *Mortimer Lansing* and *C. R. Davison*, portable summer air conditioner; and *E. D. Greiner* and *George Scheele*, dealer development.

Crane Co., Chicago, has established a research and *Institute*. Nucleus of the Institute personnel comes from "The Home Desirable," monthly magazine sponsored jointly by Crane and several hundred master plumbers, with which publication it will be directly associated. The Institute will act in the capacity of information bureau within the industry and to the general public.

Gar Wood Industries, Inc., Air Conditioning Div., Detroit, has named the *Howell Co.*, 401A Delaware Ave., Wilmington, Del., as distributor in the Delaware, Maryland and Virginia peninsula territory.

Hancock Valve Division of Consolidated Ashcroft Hancock Co., Bridgeport, Conn., has added *James A. Gibbons* to its field sales organization. He will specialize in industrial power plant and public utility construction work.

Iron Fireman Manufacturing Co., Portland, Oreg., has announced a free trip to Florida next winter for top salesmen. Members of the Super Iron Men Society of the company, representing men who have sold at least 100 stokers in the period between January 1 and December 31, 1937, and have been graduated from the Iron Fireman-La Salle training course, are eligible for the tour.

Kieley & Mueller, Inc., New York, has announced that *Joseph O'Connor* is again president of the company, after an absence of two years, during which time he headed a textile concern. Prior to 1935 Mr. O'Connor was president of Kieley & Mueller for over 12 years.

AUDITORIUM *Announces*

ROYALTY RATES *Reduced** **AGAIN**

IN 1936—due to the greatly increased number of owners who installed Auditorium Systems, we were able to provide a REDUCTION IN OUR ROYALTY RATE.

NOW . . IN 1937 with another great increase in the number of users of Auditorium Systems, especially of installations below 25,000 CFM capacity and in view of the rapidly increasing volume of sales of Auditorium Licensed Units . . .

Royalties Are Again . . REDUCED*

on a graduated scale on Central Station Systems under 25,000 cubic feet of air per minute and the sizes and types of UNIT AIR CONDITIONERS *HAVE BEEN CHANGED.*

Auditorium Air Conditioning Systems (the achievements of the leaders in Air Conditioning) with their extensive variety of adaptations, benefits and economies, are now available to you at remarkably small royalty charge.

Our Licensees, listed below, will gladly explain the notable advantages of using Auditorium Systems and the reduced royalty rates. They are prepared to install an Auditorium System for you or give your own contractor permission to do so.

TAKE ADVANTAGE OF THE *NEW LOWER RATES*

AMERICAN BLOWER CORPORATION—Detroit, Mich.
BUFFALO FORGE COMPANY—Buffalo, New York
CARRIER CORPORATION—Newark, New Jersey.
FRICK COMPANY—Waynesboro, Pa.
GENERAL ELECTRIC COMPANY—Schenectady, N. Y.
J. O. ROSS ENGINEERING CORP.—New York, N. Y.
THE COOLING AND AIR CONDITIONING CORP.—(Division of B. F. Sturtevant Co.) Hyde Park, Boston, Mass.
WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY—East Pittsburgh, Pa.
YORK ICE MACHINERY CORPORATION—York, Pa.

*Subject to change without notice.

AUDITORIUM CONDITIONING CORPORATION
New York Office 17 East 42nd Street New York

For a century the coming of a comet has been predicted and, upon the minute, it blazes its fiery way across the sky. And the mighty telescope had already been directed at the precise area where it was expected to appear.

Precision is the outstanding feature of Master Heat Regulators. They respond instantly to changes in temperature as little as one degree. Architects, contractors, dealers and users are enthusiastic over their dependable performance. Their precision and reliability are the result of over twenty years constant effort to build the best.

Type B 22
Dealers' Cost $14.10

The ideal, low cost heat regulator for small homes. So staunchly is it made that it outlasts the heating plant. The Master is listed as standard by the Underwriters' Laboratories.

Write for Complete Information

WHITE MANUFACTURING COMPANY
2364 University Ave., St. Paul, Minn.
MAKERS OF THE FAMOUS TYPE B-144, THE ORIGINAL GRADUAL CONTROL HEAT REGULATOR

MASTER HEAT REGULATOR

Jas. P. Marsh Corp., Chicago, has appointed *J. M. Appleton*, 816 12th St., Denver, Colo., as its representative in Colorado and Wyoming.

The Mercoid Corp., Chicago, has transferred *Bassett Lerch* from the Chicago factory to St. Louis, Mo., with headquarters at 8787 Bridgeport Ave.

Russell MacDonald is now associated with the Boston office at 25 Ivy St., and *Paul J. Provost* in the Philadelphia office at 3137 N. Broad St.

Owens-Illinois Glass Co., Toledo, Ohio, has named *Stanley J. McGiveran*, formerly assistant general sales manager of the glass container division, director of advertising—a newly-created position. *T. K. Almroth* is advertising manager.

Penn Electric Switch Co., Des Moines, Iowa, has named *R. H. Luscombe* sales manager. Formerly manager of the company's New York office, Mr. Luscombe's headquarters will be at Goshen, Ind., new home office of Penn.

Perfex Controls Co., Milwaukee, Wis., has appointed *Ben L. Boalt* vice-president. Formerly a director and vice-president of Penn Electric Switch Co., Mr. Boalt was at one time secretary and a director of the old Minneapolis Heat Regulator Co. He continued in these capacities when Minneapolis-Honeywell Regulator Co. was formed. When the Time-O-Stat Controls Co. was acquired, he was made manager of the Elkhart, Ind., plant.

Utica Radiator Corp., Utica, N. Y., announces that *Carl Sawade*, general sales manager, will also assume sales direction of its new air conditioning division which is introducing the Utica air conditioner. Mr. Sawade will divide his time between Utica and the recently opened New York office at 101 Park Ave. He will coordinate the sales of Utica boilers and radiators with the air conditioning equipment through branch offices, distributors, dealers and time payment department.

Following appointments to the air conditioning division have been made: *Grant H. Browne*, in charge of the distributor and dealer sales; *Walter Sherbrooke*, chief sales and installation engineer—both to have headquarters in New York. *ABC Oil Burner and Engineering Co., Inc.*, 2012 Chestnut St., Philadelphia, has been named distributor of the company's air conditioner in the metropolitan Philadelphia territory.

Worthington Pump and Machinery Corp., Harrison, N. J., has named *J. J. Summersby*, assistant vice-president, as general sales manager. This appointment is an extension of Mr. Summersby's previous responsibilities.

NEW CATALOGS

(Unless otherwise indicated the publishers of catalogs will supply copies on request without charge.)

ARMSTRONG CORK CO., Lancaster, Pa. Four folders describing the Armstrong line of insulation. One booklet is devoted to each of the following: LK corkboard, which was developed especially for refrigerated equip-

ment; Temlock, fibreboard insulation for use in cabinet construction; and Armstrong-Corning wool, a fibrous glass insulation. The fourth booklet summarizes the features of all three products and gives information on the Armstrong's life test room which is maintained for making efficiency tests under various temperature and humidity conditions.

Auburn Automobile Co., Air Conditioning Div., Connersville, Ind. Large two-color broadside describing the new Auburn all-year air conditioners. The unit cools, cleans, ozonizes, and circulates air.

Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio. A 40-page catalog, No. 301, on Bailey fluid meters for steam, liquids, gases. Bulletin illustrates the manner in which any desired combination of indicating, recording and integrating features may be combined with a flow mechanism suitable for the measurement of steam, liquid or gases under high, low or medium pressure. Gives information on flow mechanisms, integrated and auxiliary recorders.

Century Electric Co., 1806 Pine St., St. Louis, Mo., has published two standard size bulletins, Nos. 1032 and 1033. Bulletin 1032 deals with slip ring motors from 1 to 350 hp., while bulletin 1033 deals with direct current motors of 1 to 300 hp. Included is information on construction, operating characteristics, and types available.

Combustion Engineering Co., Inc., 200 Madison Ave., New York, has published a standard-size catalog on the CE-Skelly stoker unit for small commercial and industrial installations. Gives specifications and engineering data.

Ingersoll-Rand Co., 11 Broadway, New York, has published bulletin 9143, describing the application and advantages of steam jet water-vapor refrigerating units. These units are available in sizes from 10 tons of refrigeration upward for operation at steam pressures as low as 2 lb.

Ingersoll-Rand Co., Cameron Pump Div., 11 Broadway, New York. A standard-size bulletin, No. 1972-B, illustrating the Cameron Motorpump condensate unit. Bulletin shows applications and gives information regarding sizes and capacities.

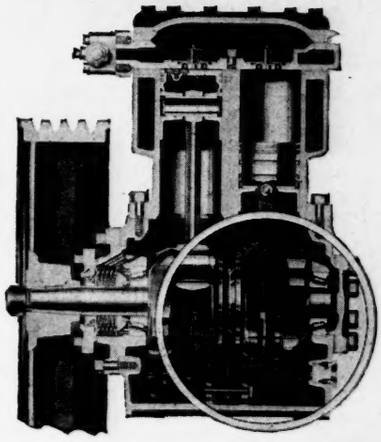
Iron Fireman Manufacturing Co., 3170 W. 106th St., Cleveland, Ohio. Booklet on planning modern basements to include furnace room, play rooms, and laundry room. Drawings reproduced in the booklet were submitted in the recent Pencil Points-Iron Fireman architectural competition.

Liberty Foundry Co., 7600 Vulcan St., St. Louis, Mo., has published a 12-page, standard-size catalogue, No. 37, describing the Syox forced air and the Symonds gravity registers. Gives insulation data, list prices, and mechanical details, of various types of registers and grilles.

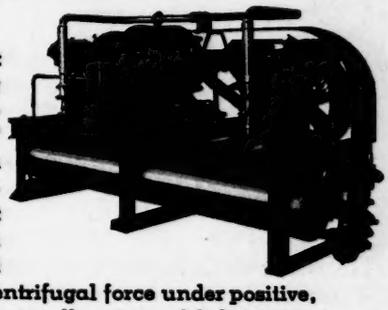
C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y., has published a new Tag laboratory thermometer and hydrometer catalog, No. 1100A. In addition to the regular line of extreme precision and

CURTIS

Condensing Units



"CENTRO-RING" LUBRICATION—
—*only*
CURTIS COMPRESSORS
have it



THERE'S just one moving part in Curtis "Centro-Ring" lubrication—a simple, free running ring that picks up oil from the crankcase and distributes it by centrifugal force under positive, uniform pressure to all points of lubrication—no gears—no plungers—nothing to get out of order or require service.

Engineering superiorities of this kind have built the Curtis reputation for reliability, long operating life and low cost of upkeep.

The Curtis line contains 41 air-cooled units, from 1/6 HP to 5 HP, inc., and 45 water-cooled units from 1/3 HP to 30 HP — a size and type to balance most any installation you might make. Curtis has built condensing units for 15 years and has made engineering equipment for 82 years — a record of success that in itself is sufficient warranty of the high-quality of Curtis units of today.

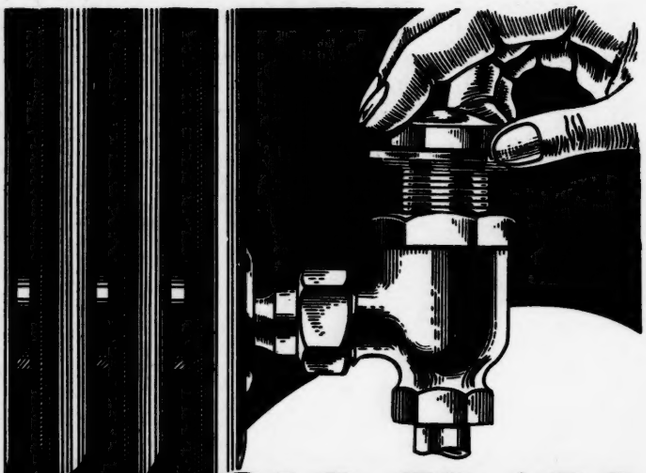
CURTIS Engineering Refinements

- Centro-Ring — one piece, positive pressure lubrication
- Timken Tapered Roller Bearings
- V-type radial compressor
- Water-jacketed compressor heads and cylinders
- Built-in oil separator with automatic return
- Drop forged, heat treated crankshafts and rods
- Balanced syphon, bellows seal
- Automatic water valves

Represented in Canada by
Canadian Curtis Refrigeration Co., Ltd.
20 George St., Hamilton, Ont., Can.

CURTIS REFRIGERATING MACHINE CO.

"Builders of Condensing Units since 1922"
1958 Kienlen Ave., St. Louis, U. S. A.



OLD TRAPS MADE *NEW*

Vacuum and vapor heating systems cannot be efficient with leaky traps on the radiators and drips. For leaky traps waste steam, prevent proper circulation and cause noise.

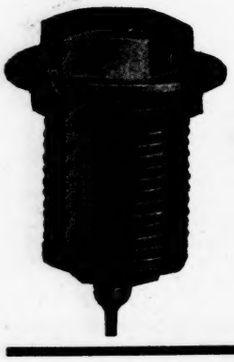
It is no longer necessary to waste money by scrapping leaky radiator traps. Traps of any make can be made equal to new in steam saving with

Sarco Adapters

They can be screwed into the old bodies of traps as well as inlet valves without disturbing pipe connections.

This not only saves much money over the cost of buying new traps and valves but also saves about one-half the installation cost.

Make a hit with your customers by showing them how to save money with Sarco Adapters.



Write for Particulars and Catalog P-111

SARCO CO., INC.
183 Madison Ave.
New York N. Y.
Branches in Principal Cities
SARCO CANADA, Limited
Federal Bldg., Toronto, Ont., Canada

standard grade Tag thermometers and hydrometers, this catalog includes complete listings of A.S.T.M. thermometers, as well as the Tag-A.P.I. and Tag certified hydrometers. Useful data including comparison scale graduations, corrections for emergent stems, instructions for using hydrometers and Fahrenheit and Centigrade conversion tables are retained and amplified.

TORRINGTON MANUFACTURING CO., Torrington, Conn., has published a new bulletin describing the standard model of its improved line of Aristocrat silent fans. Included is information pertaining to material, finishes, rotation, blade sizes, hubs, and air deliveries.

COMING EVENTS

AUGUST 3-7, 1937. Power Show and Mechanical Exposition, The Universal Craftsmen Council of Engineers of the World, Hotel Stevens, Chicago.

AUGUST 22-28, 1937. National Warm Air Heating and Air Conditioning Week. Headquarters, Suite 635, 407 S. Dearborn St., Chicago, Ill.

AUGUST 30-SEPTEMBER 3, 1937. National Convention, National Association of Power Engineers, Inc., Jefferson Hotel, St. Louis, Mo.

SEPTEMBER, 1937. Quarterly Meeting, Stoker Manufacturers Association, Chicago, Ill.

SEPTEMBER 27-OCTOBER 1, 1937. 19th Annual Convention, American Gas Association, Hotel Cleveland, Cleveland, Ohio.

OCTOBER 4-6, 1937. Fall Meeting, American Society of Mechanical Engineers, Lawrence Hotel, Erie, Pa.

OCTOBER 4-9, 1937. Chicago Exposition of Power and Mechanical Engineering, International Amphitheater, Chicago. Charles F. Roth, Grand Central Palace, New York.

OCTOBER 5-8, 1937. 66th Annual Meeting, American Public Health Association, Hotel Pennsylvania, New York

OCTOBER 18-22, 1937. 18th Annual Meeting, American Welding Society, Hotel Traymore, Atlantic City, N. J.

OCTOBER 18-22, 1937. National Metal Exposition (including Welding) Convention Hall, Atlantic City, N. J. W. H. Eisenman, American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio.

NOVEMBER 9-12, 1937. 18th Annual Meeting, American Petroleum Institute, Stevens Hotel, Chicago.

DECEMBER 6-10, 1937. Annual Meeting, American Society of Mechanical Engineers, New York.

DECEMBER 6-11, 1937. 16th Exposition of Chemical Industries, Grand Central Palace, New York.

DECEMBER 27-28, 1937. Drying and Air Conditioning, Subject of 4th Annual Chemical Engineering Symposium of the American Chemical Society, University of Pennsylvania, Philadelphia.

JANUARY 24-28, 1938. 5th International Heating and Ventilating Exposition, Grand Central Palace, New York. Charles F. Roth, Grand Central Palace, New York.

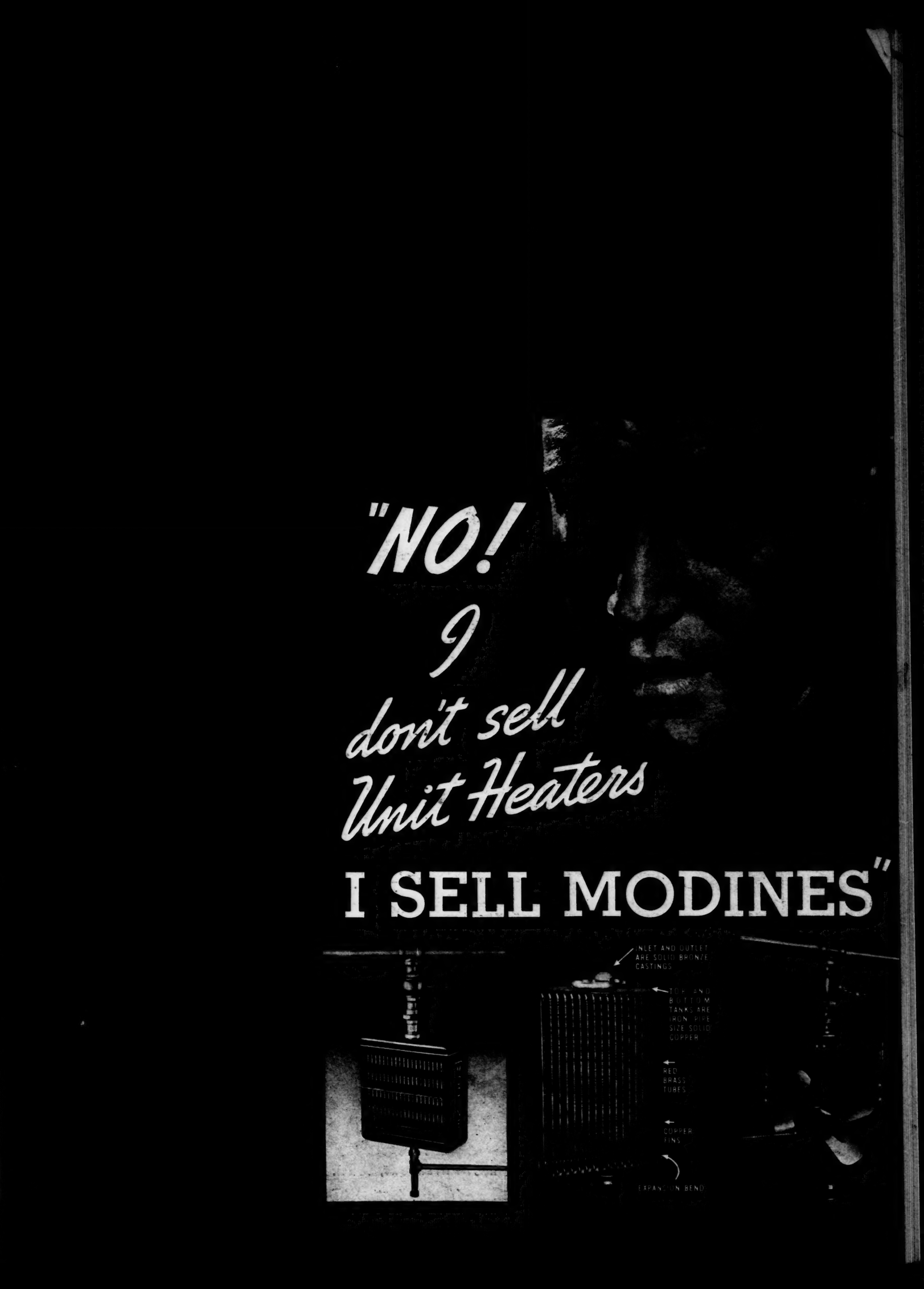
JANUARY 24-28, 1938. 44th Annual Meeting, American Society of Heating and Ventilating Engineers, New York.

JANUARY 24-28, 1938. Annual Meeting, National Warm Air Heating & Air Conditioning Association, Hotel Roosevelt, New York.

JANUARY 24-28, 1938. 33rd Annual Meeting, American Society of Refrigerating Engineers, Hotel Roosevelt, N. Y.

APRIL 11-16, 1938. Mechanical Equipment Show, Textile Hall, Greenville, S. Car. William G. Sirrine, President, Textile Hall Corp., Greenville, S. C.

DECEMBER 5-10, 1938. 13th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.


"NO!
I
don't sell
Unit Heaters
I SELL MODINES"
INLET AND OUTLET ARE SOLID BRONZE CASTINGS
TOP AND BOTTOM TANKS ARE IRON PIPE SIZE SOLID COPPER
RED BRASS TUBES
COPPER FINS
EXPANSION BEND